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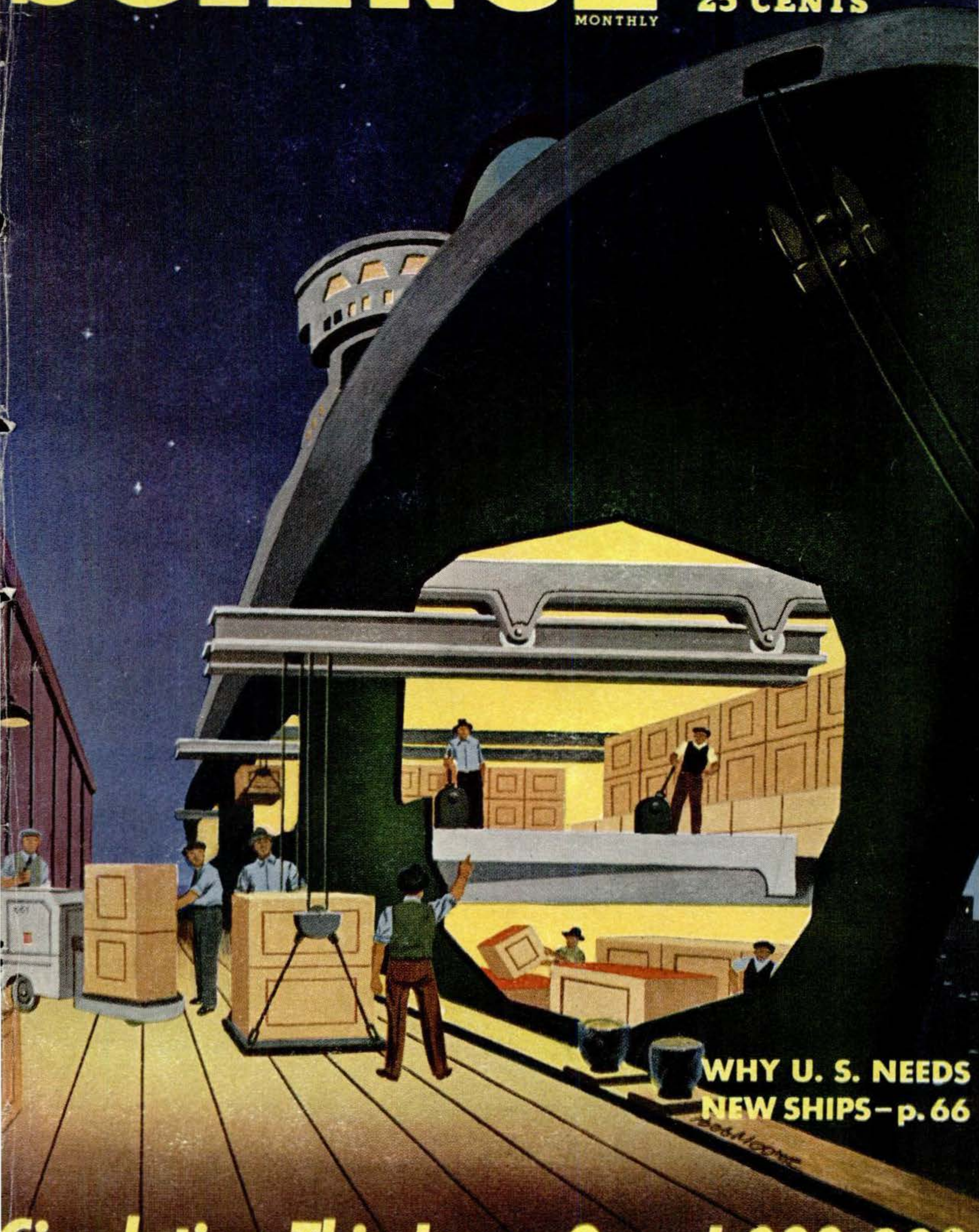

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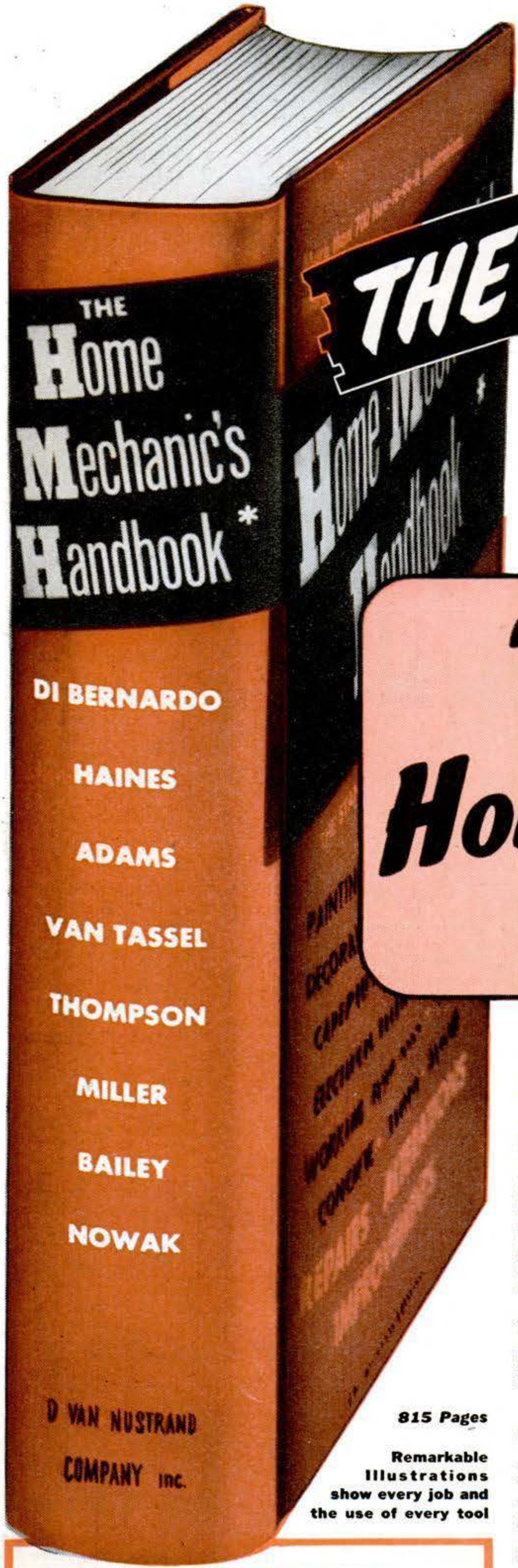

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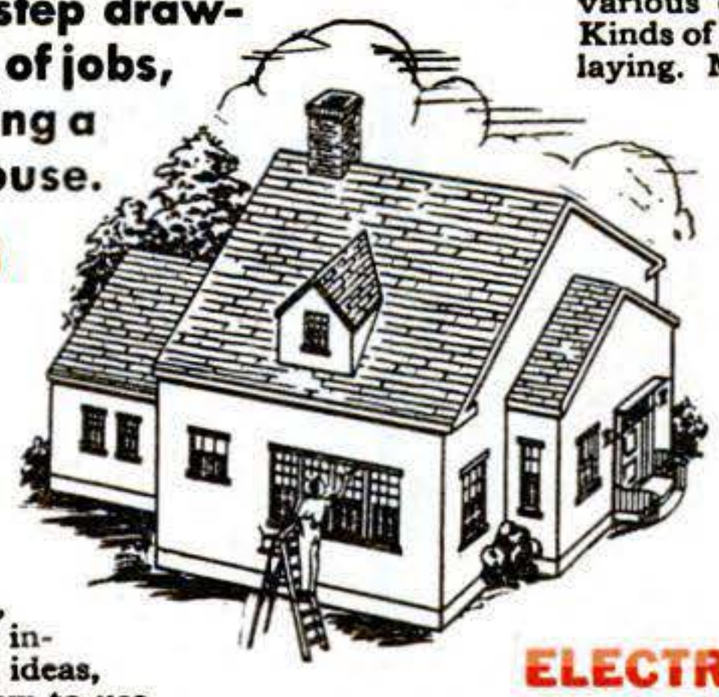

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Mechanics & Handicraft

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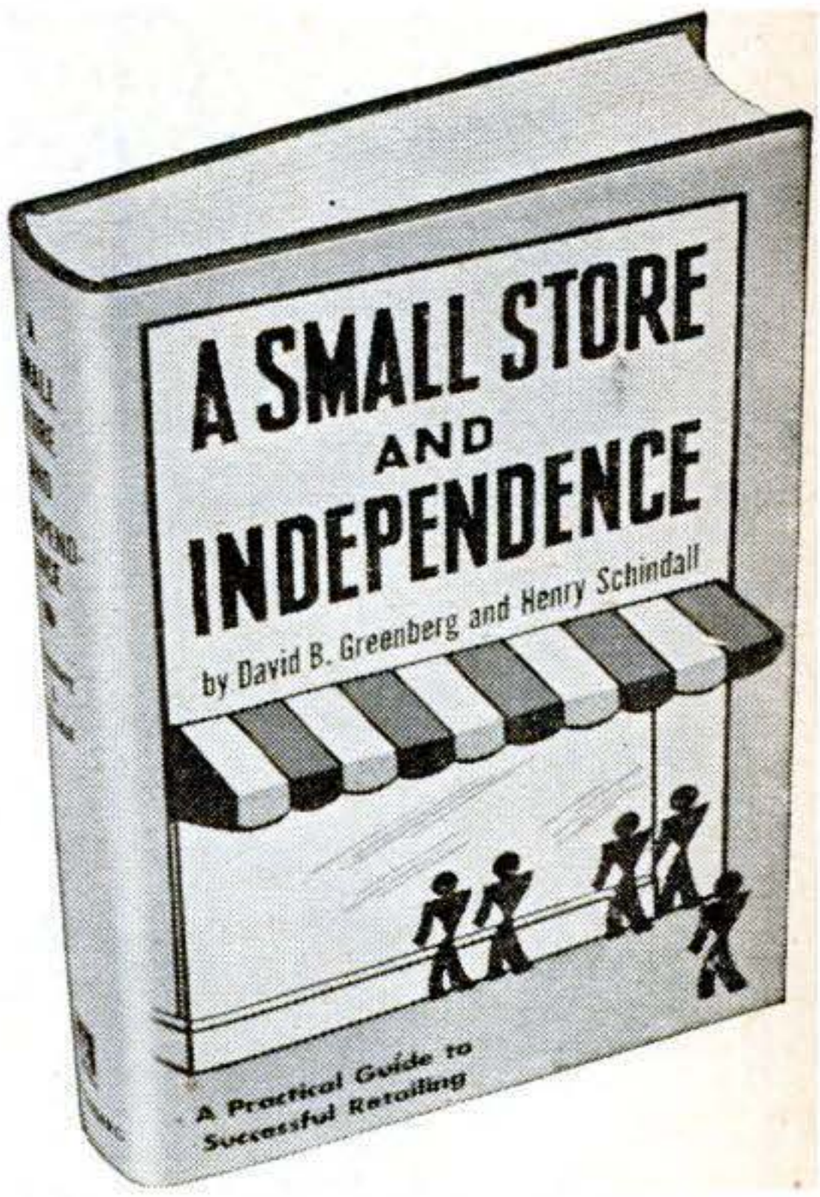

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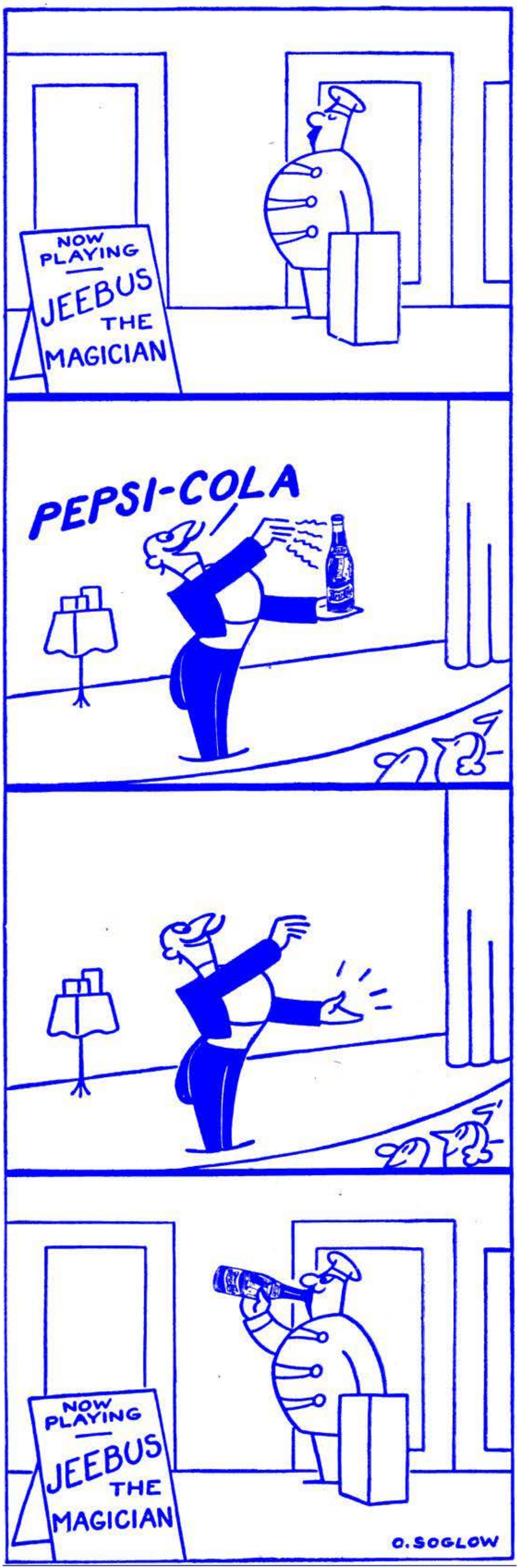

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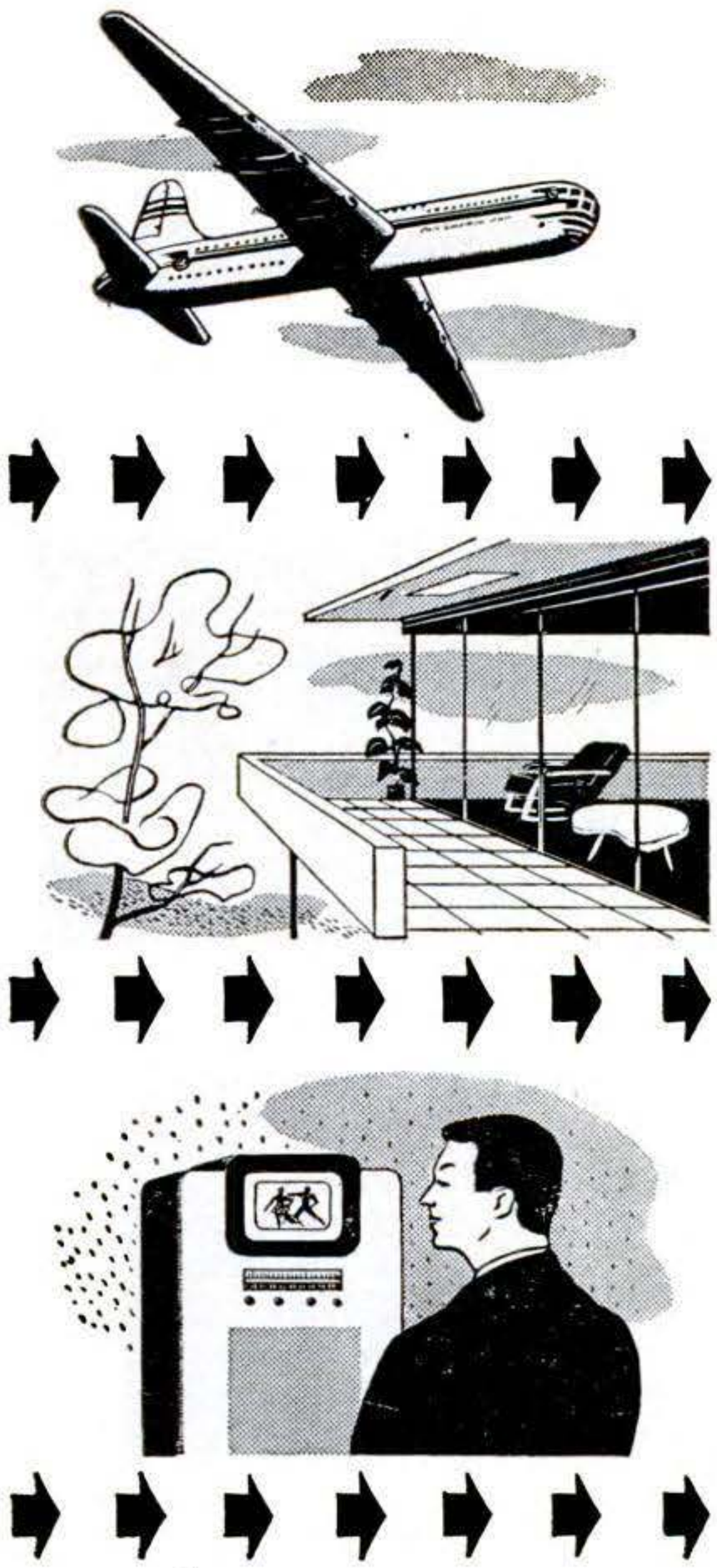

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TO: Reader
FROM: Editor

These editors are *ARTISTS*

Pictures are a big part of *Popular Science Monthly*. Pictures that tell a story all their own; pictures that illustrate a point or a process; pictures that let you look inside whirring machines; paintings, drawings, and photographs to show you how things work or how to make things. In fact, there are 420 pictures in this February issue — which makes Popular Science a "picture digest" as well as a journal of scientific theory and practical mechanics. So let me tell you about some of the people who put the pictures into these pages.

de SANTIS

Michele de Santis has been "Mike" around the Art Department for 14 years. He studied mechanical engineering at New York University and architecture at Columbia. From T-square and triangle he moved to charcoal and oil at Grand Central and New York School of Design, where he later taught commercial art. Eventually, this combination of engineering and art found the perfect outlet—and de Santis has been a working art director at Popular Science ever since. His special facility, understandably, is the projection of an idea drawn with a dull pencil on an old envelope into complete working plans with a slick perspective sketch of the finished job.

SAMUELS

Harry Samuels was born in London and came to this country as a boy in 1917 when the U-boats were loose in the Atlantic. While still in New York's Stuyvesant High School, he got into the printing business. After more training in the production end of advertising, in 1927 he took this handy knowledge to Popular Science, where he works with type, pictures, and color. Over the years, Samuels has scanned, selected, and scaled many thousands of photographs, in spite of which his hobby is photography. An important part of his work as a PSM art director is combining words and pictures into page layouts that invite the eye as well as the mind.

ROUSE

Stewart Rouse is the staff artist who has made so many of the cutaway drawings that help the rest of us to understand such commonplace complexities as the automatic transmission, and the radio proximity fuse. Incidentally, the Bureau of Standards said Rouse's pictorial explanation of the VT fuse (PSM, Dec. '45, p. 86) was the clearest available, asked (and was granted) permission to use the drawings. Rouse is a lanky Lincolnesque character who came from the tall corn country by way of Chicago's famous Art Institute. Perhaps because of his own altitude (6 ft. 4½ in.) he has always been somewhat air-happy, once built a homemade airplane that a harsh government refused to let him fly.

DUKLER

Samuel Dukler is another PSM staff member who combines engineering with art. Born in New Haven, he naturally went to Yale's Sheffield Scientific School, then unnaturally transferred to the School of Fine Arts, taking his degree in architecture. He worked as an architectural designer, turned to illustration, then back to architecture in New York where he helped on the East River Drive blueprints.

MACGUIRE

Robert Reid Macguire, PSM's new Art Editor, is an old hand in the business of pictures on paper. A short and solid Scot, Macguire wore kilts until he pulled on his first long trousers in this country. A GI in World War I, he stayed on in France after the fighting, studied at the Ecole des Beaux Arts, Les Arts Decoratifs, and Academy Julien in Paris. He has worked as a designer of stage settings, as art director of one of New York's biggest department stores, as an instructor in layout, as an industrial designer, and as an editorial and advertising art consultant. His job at Popular Science is to sit down with the managing editors, the writers, and myself, to work out, around the long table in my office, the best possible editorial treatment of a story—whether that treatment calls for all pictures, all text, or a happy combination of both.

The editors of *Popular Science Monthly*, as engineers and artists and writers, consider their chores collectively. Our job is to turn out a complete yet compact notebook of science for the citizen, and an understandable manual of the mechanics of living.

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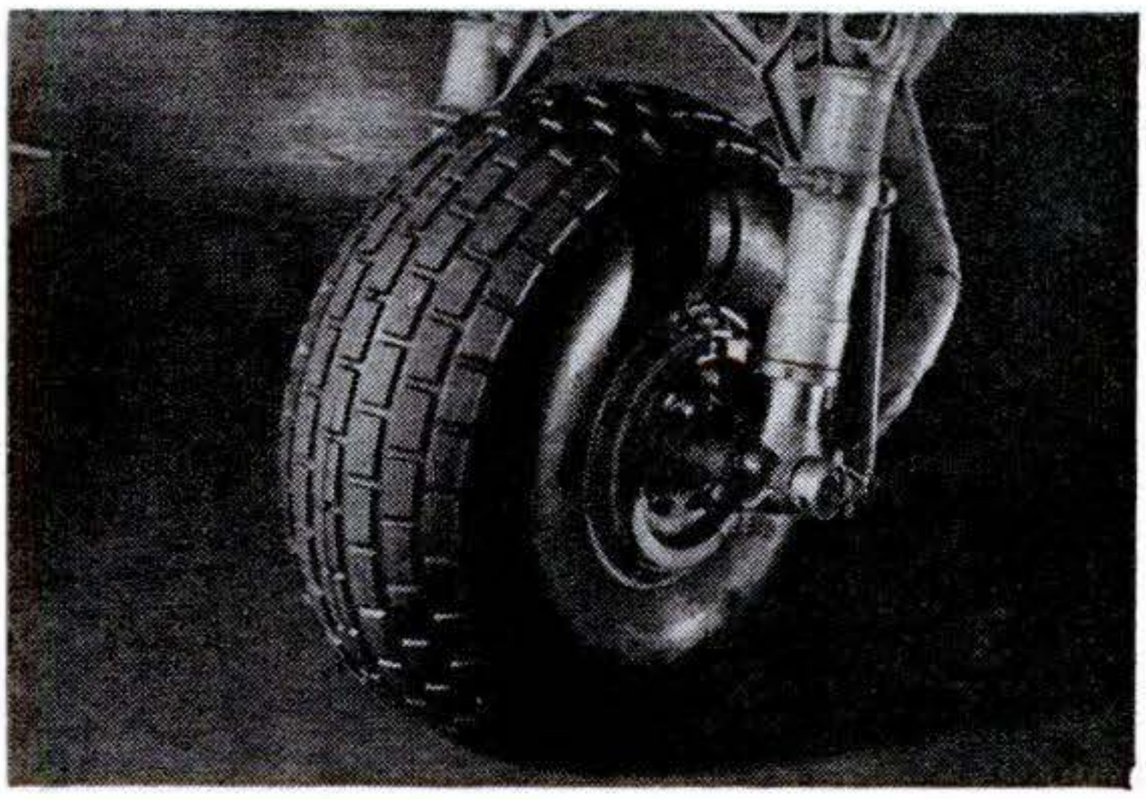

"U. S.", too, has stepped out to make aviation history. Its pioneering of rayon and nylon cord bodies was the beginning of the truly modern airplane tire . . . geared to the needs and the demands of today's airplanes . . . from two-seaters to super-transports.

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Here are more things to make and do than have ever been crammed into a single volume at this low price. From a simple metal ashtray to a 9x12 hooked rug, 250 projects in *paper, leather, glass, metal, wood, fabric, plastics,* and *clay* are clearly explained with equipment needed. Simplified working drawings and step by step instructions make it very easy to turn out beautiful finished handicraft that everyone is sure to admire. Full instructions in *batik, basketry, carving, etching, jewelry, metal craft, stenciling,* and *sixteen other crafts.* Shows you how to make albums, moccassins, toy furniture, dog leashes, ash trays, gloves, jewelry, waste baskets, lamp shades and hundreds of other useful and artistic articles. **PRICE $1.50**

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Whether your dream home is as modern as tomorrow or in traditional American style, you will want it to be comfortable up-to-date and convenient. Royal Barry Wills gives you the advice you need, whether you plan to spend $2,500 or $12,000 for your new home. Contains: 50 plans and sketches of complete homes—100 hints for home builders from choosing the site to papering walls, illustrated from the architect's scrapbook—10 pages of details, complete drawings of finishing touches that make a house a home. Also advice on forthcoming designs, gadgets, materials, heat, bathrooms, kithens, etc. **$1.00**

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19. METALCRAFT & JEWELRY

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Packed with money-saving, time saving and trouble saving information about home repair jobs that you can do yourself. Whether you want to reshingle your roof, stop a dripping faucet, replace part of your plumbing, patch a broken concrete walk or do scores of other useful and important house repair jobs, this book shows you how to do it in the simplest and most economical way. **$1.00**

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If YOU were *Boss* would YOU *promote* "YOU"?

Be honest now—

suppose that a better job had opened up in your company—carrying with it promotion and more money—could you qualify?

If you were boss, would you select "YOU" for that better job?

Consider before you answer.

First of all, could you *fill* the job? Has your experience fitted you for the step forward—have you been preparing for promotion apart from experience gained on the job?

Or have you just been filling a niche, doing daily tasks well but making no real and intelligent effort to learn and qualify for the job ahead so that if an opening should occur you would be ready to fill it?

The man who gets real promotion is the one who makes his own breaks—the man who slaves in the ordinary job at low pay just wishes and dreams of promotion and more money. Which are you?

Business is always willing to pay the man who knows—and pay him well. The man who is ready and willing to take responsibilities—and capable of directing the efforts of other men is a valuable asset to any business organization. He never wants for a good job and above average earnings. He gets ahead.

We have helped thousands of men achieve promotion and more money—success sometimes beyond their dreams—a success that was started by a coupon similar to the one below.

Get out of that rut—don't be satisfied with a mediocre job at small pay—be a success in business—this coupon may be your first step.

So send it today—right now—tomorrow never comes for the man who consistently puts things off.

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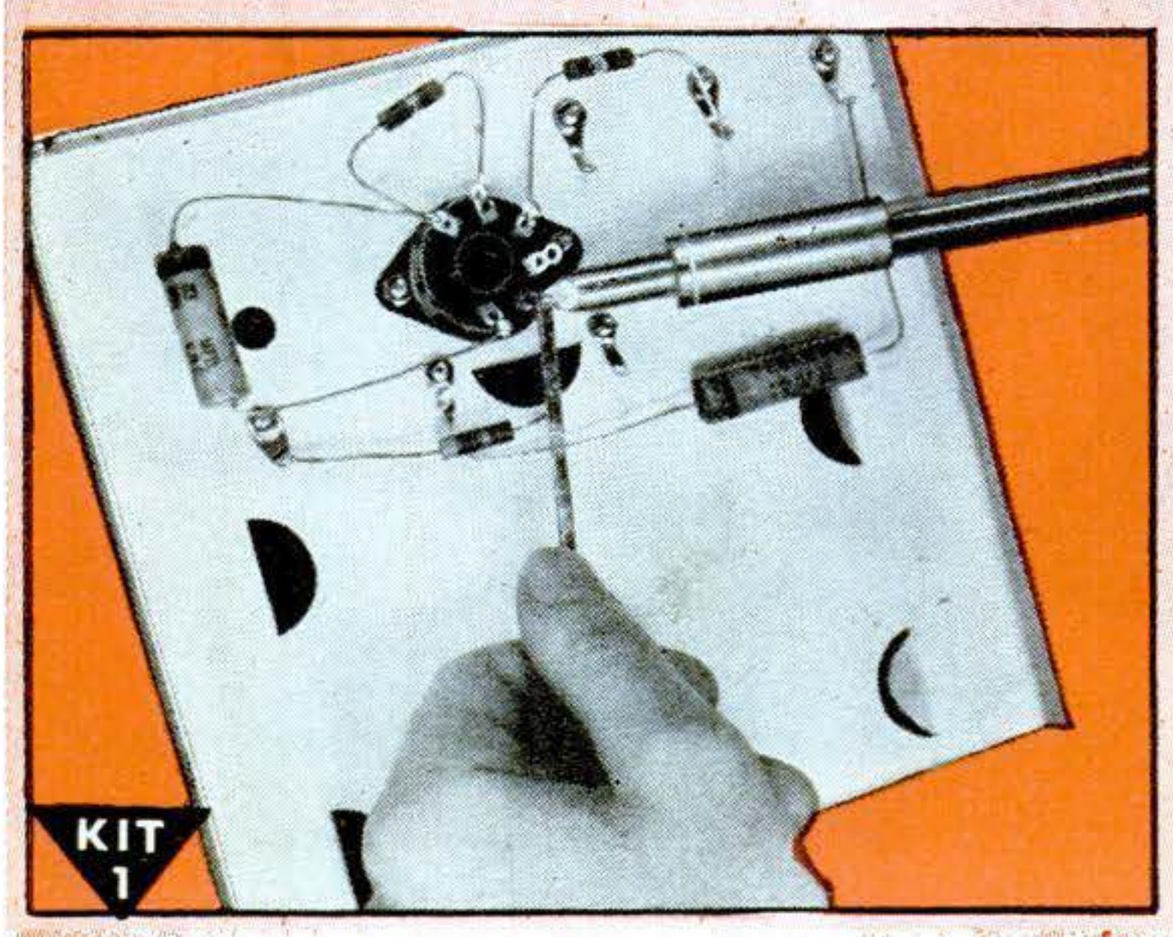
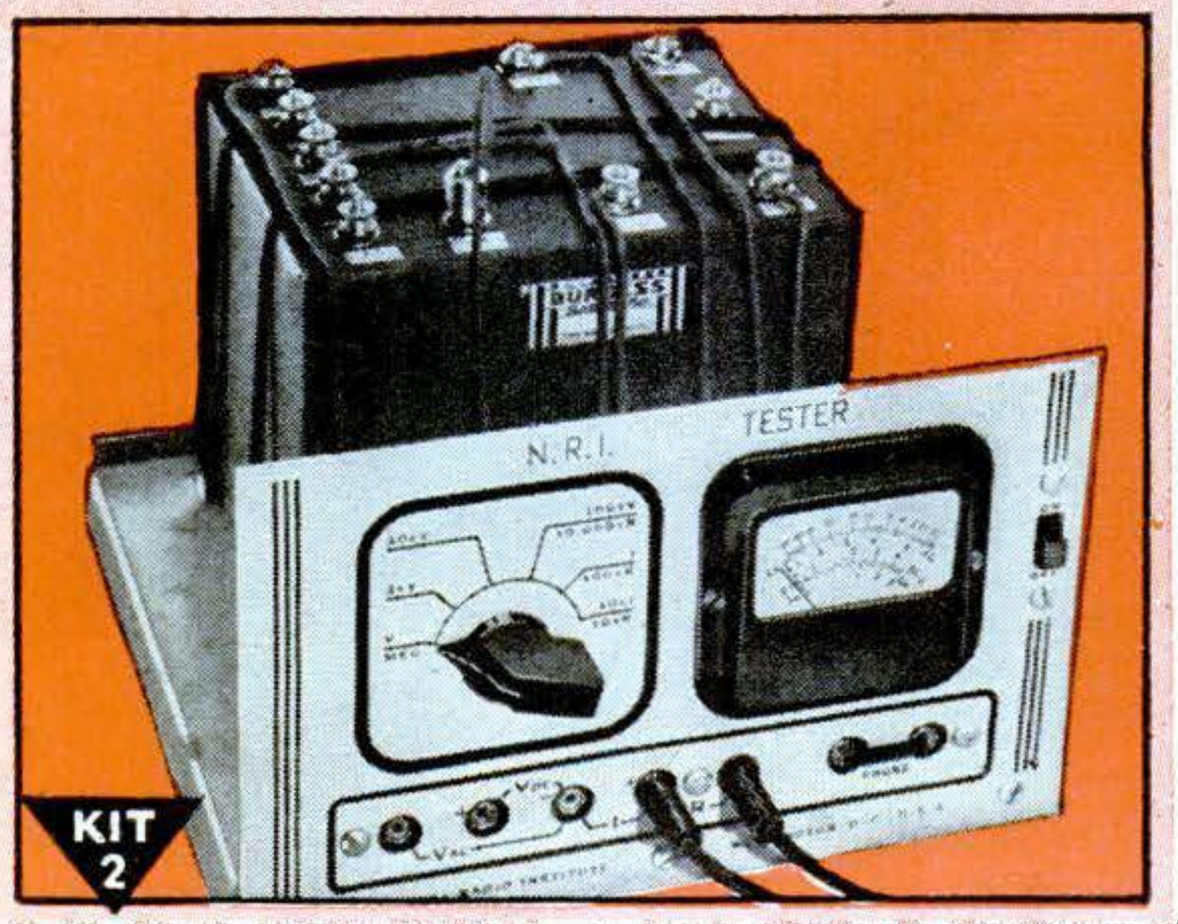
I Will Show You How to Learn RADIO



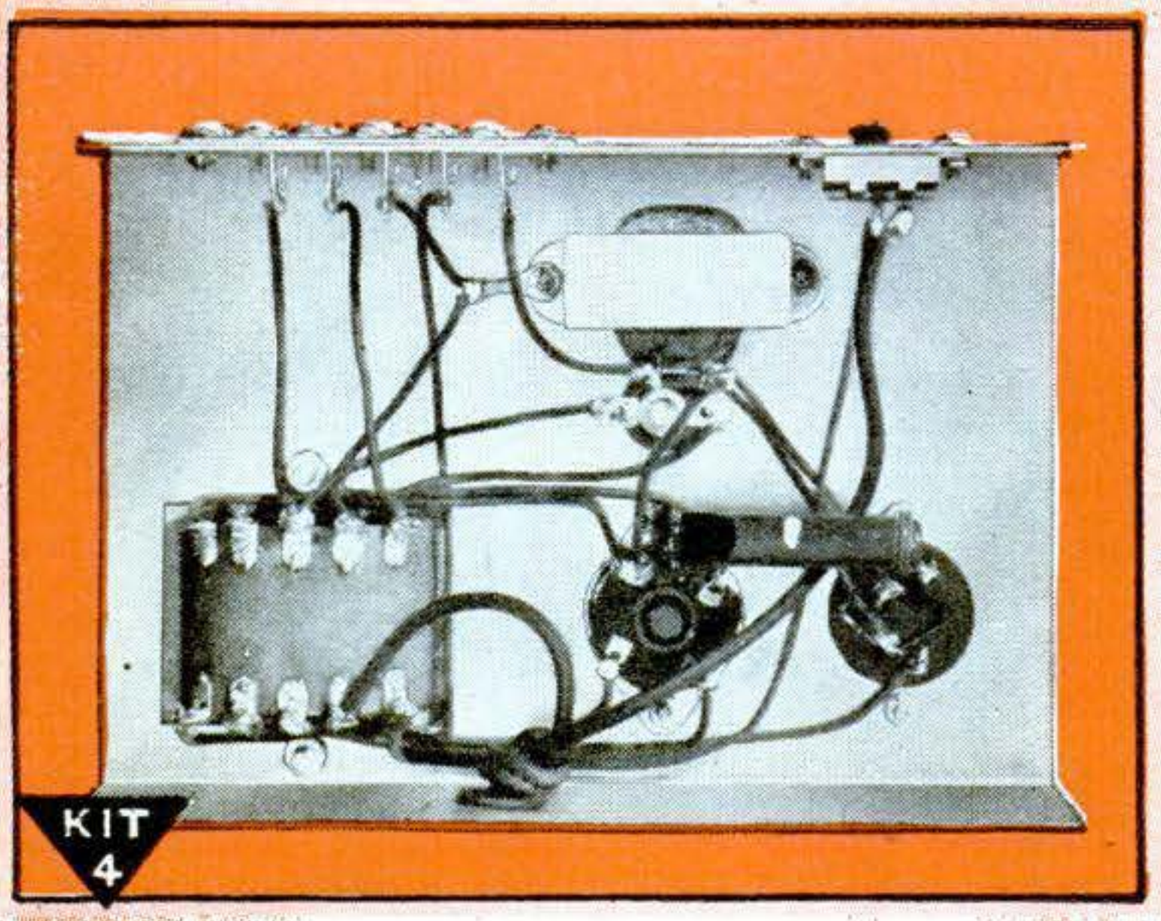
KIT 1

I send you Soldering Equipment and Radio parts; show you how to do Radio soldering; how to mount and connect Radio parts; give you practical experience.



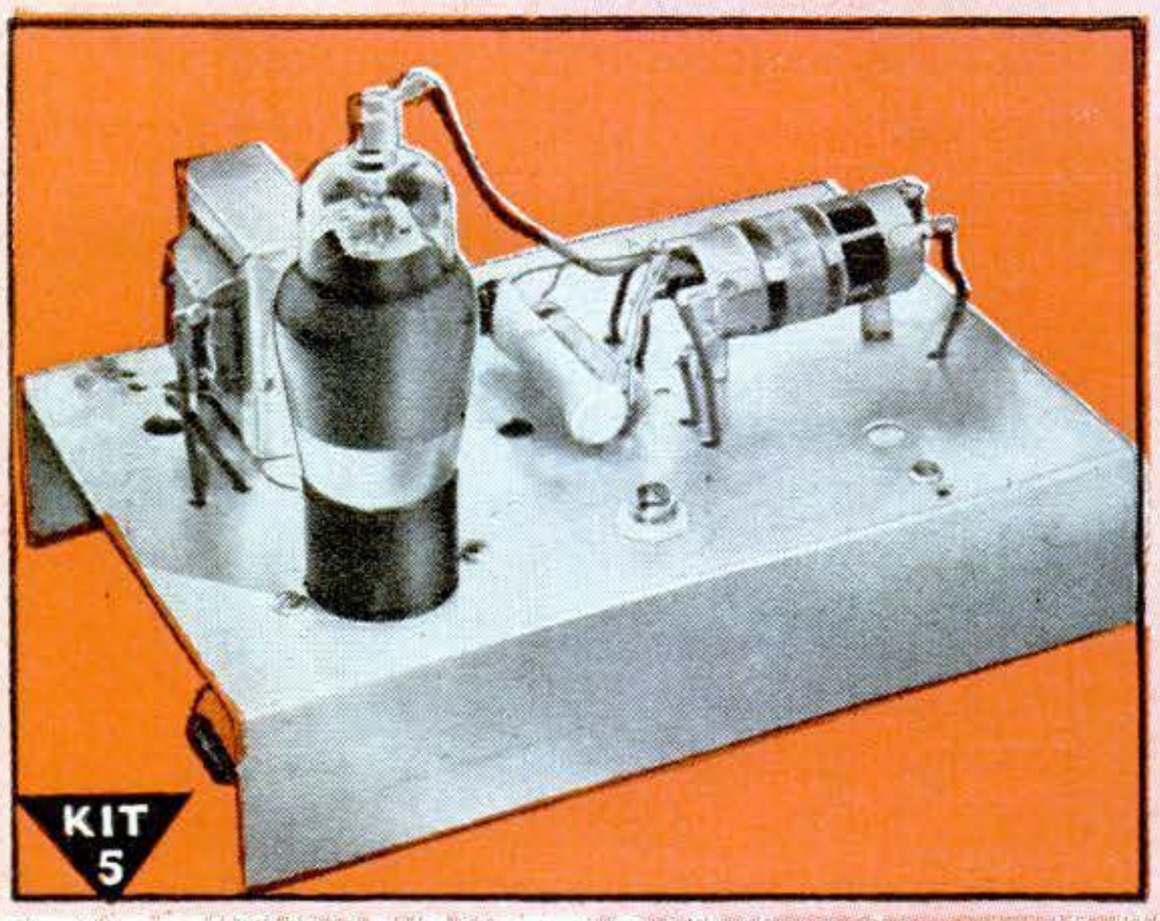
KIT 2

Early in my course I show you how to build this N.R.I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



KIT 4

You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



KIT 5

Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.

MEN I TRAIN AT HOME GET GOOD JOBS LIKE THESE

$250 a month in own shop

"I am now operating a radio shop for myself and own all my equipment. Right now I only repair radios, because there are none to sell, but I average $250 a month."—J. M. SCRIVENER, JR., Aberdeen, Miss.

Fixing Radios Profitable Hobby

"I am doing radio work in my spare time, and find it a profitable hobby. My extra earnings run about $10 a week. I certainly am glad I took your N.R.I. Course." — FERDINAND ZIRBEL, Chaseley, North Dakota.

Chief Engineer, Station KWLM

"Am now Chief Engineer of Station KWLM and in charge of maintenance of Police Station KRIN, County Highway Dept. Also have own business." —LLOYD V. STENBERG, 516 LitchfieldAve., W., Willmar, Minn.

Still Climbing in Aircraft Radio

"I am still climbing as a result of my N.R.I. training. I now do aircraft radio work at Greenwood Army Air Field, and operate a radio shop in my spare time."—JAMES L. BOYETTE, Box 218, Greenwood, Miss.

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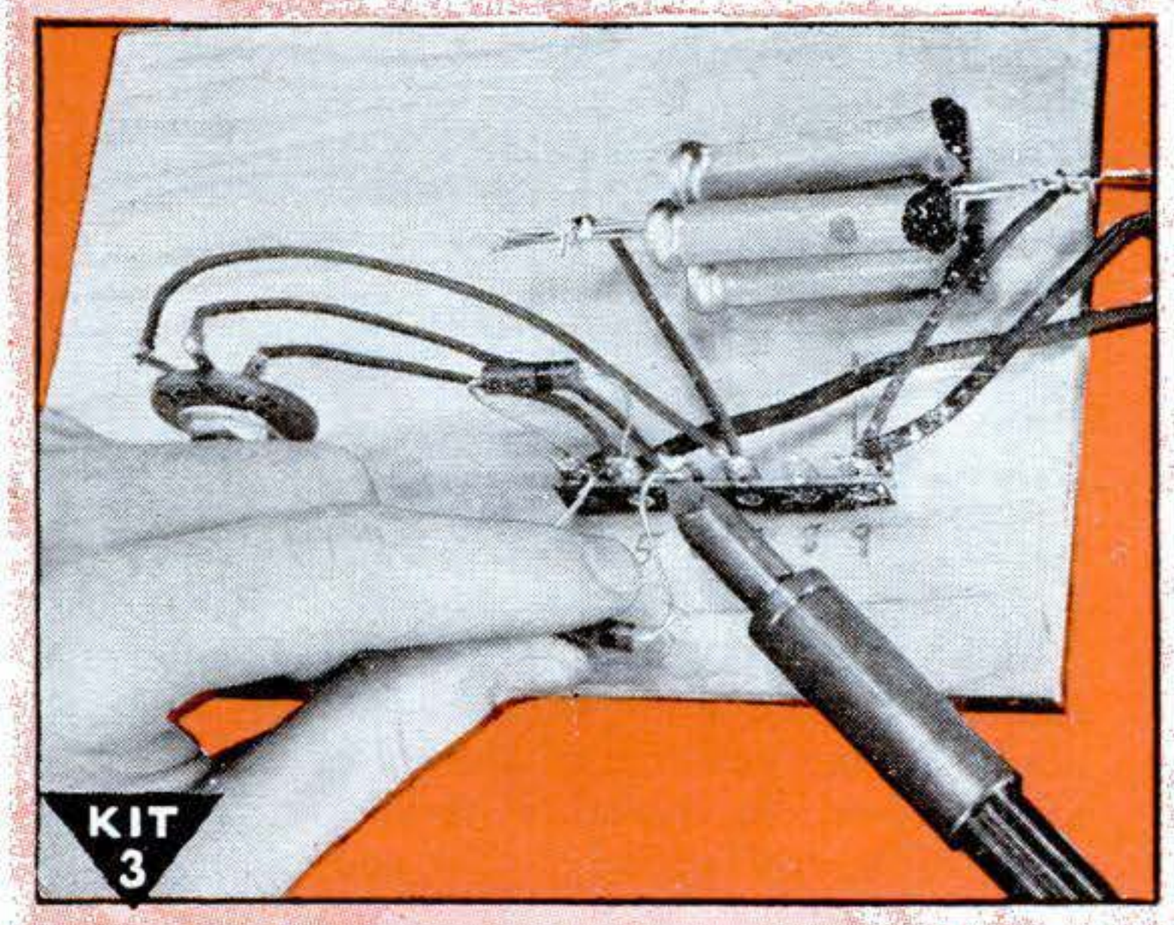
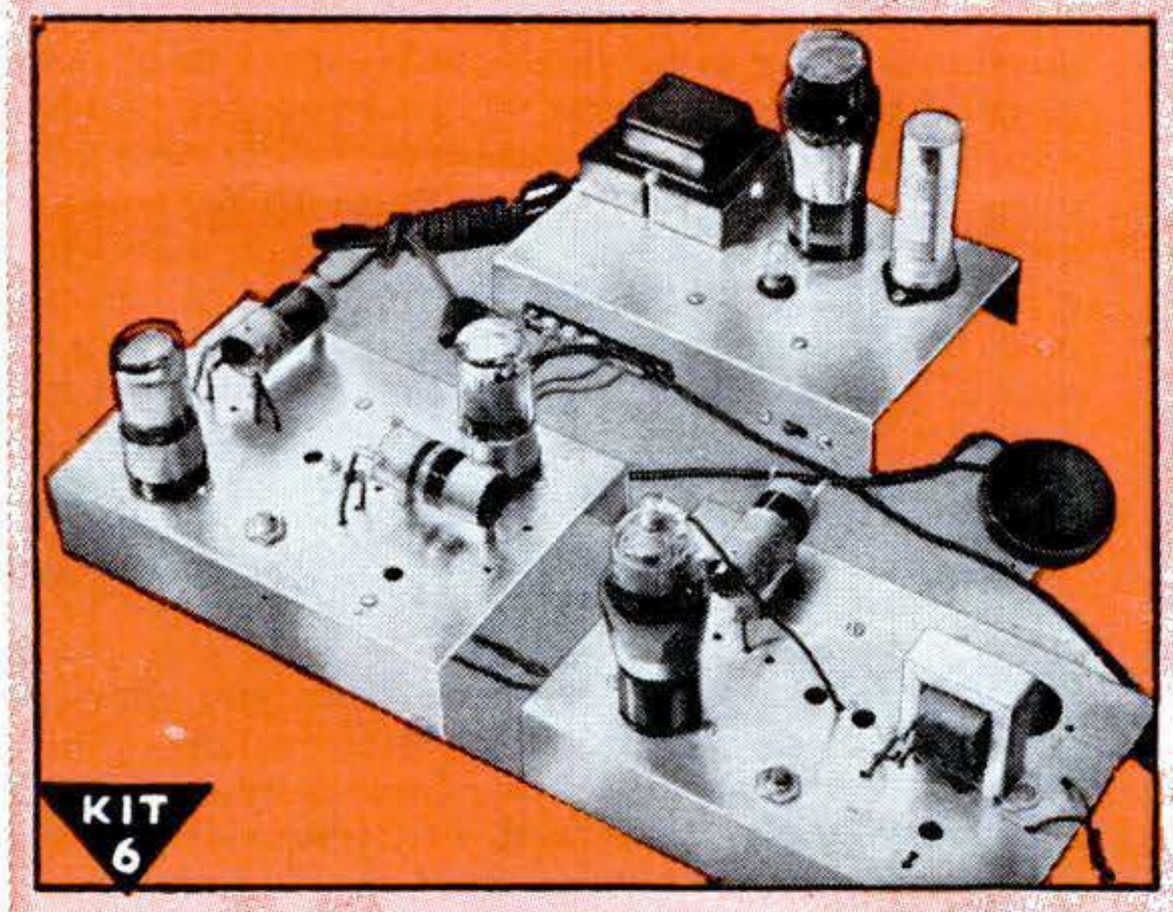
by Practicing in Spare Time

I Send You 6 Big Kits of Radio Parts



You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

KNOW RADIO *Win Success*

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Send coupon for FREE Sample Lesson, "Getting Acquainted with Receiver Servicing," and FREE 64-page book, "Win Rich Rewards in Radio." See how N.R.I. trains you at home. Read how you practice building, testing, repairing Radios with SIX BIG KITS of Radio parts I send you.

Future for Trained Men is Bright in Radio, Television, Electronics

The Radio Repair business is booming NOW. Fixing Radios pays good money as a spare time or full time business. Trained Radio Technicians also find wide-open opportunities in Police, Aviation, Marine Radio, in Broadcasting, Radio Manufacturing, Public Address work, etc. Think of the boom coming now that new Radios can be made! Think of even *greater* opportunities when Television and Electronics are available to the public!

Many Beginners Soon Make $5, $10 a Week EXTRA in Spare Time

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All things begin with thought—it is what follows that may take your life out of the class of those who hope and dream. Thought energy, like anything else, can be dissipated—or it can be made to produce actual effects. *If you know how to place your thoughts* you can stimulate the creative processes within your mind—through them you can assemble things and conditions of your world into a happy life of accomplishment. *Mental creating* does not depend upon a magical process. It consists of *knowing how* to marshal your thoughts into a power that draws, compels and organizes your experiences into a worth-while design of living.

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Let the Rosicrucians tell you how you may accomplish these things. The Rosicrucians (not a religious organization), a world-wide philosophical fraternity, have preserved for centuries the ancients' masterful knowledge of the functioning of the inner mind of man. They have taught men and women how to use this knowledge to *recreate their lives.* They offer you a free copy of the fascinating book, "The Mastery of Life." It tells how you may receive this information for study and use. Use coupon opposite.

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I'LL PROVE What I Say!

I know what it's like to have a body others laugh at. I myself was once a 97-pound weakling—timid, ill-at-ease, ashamed to strip for sports or a swim.

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Charles Atlas

Holder of title, "The World's Most Perfectly Developed Man."

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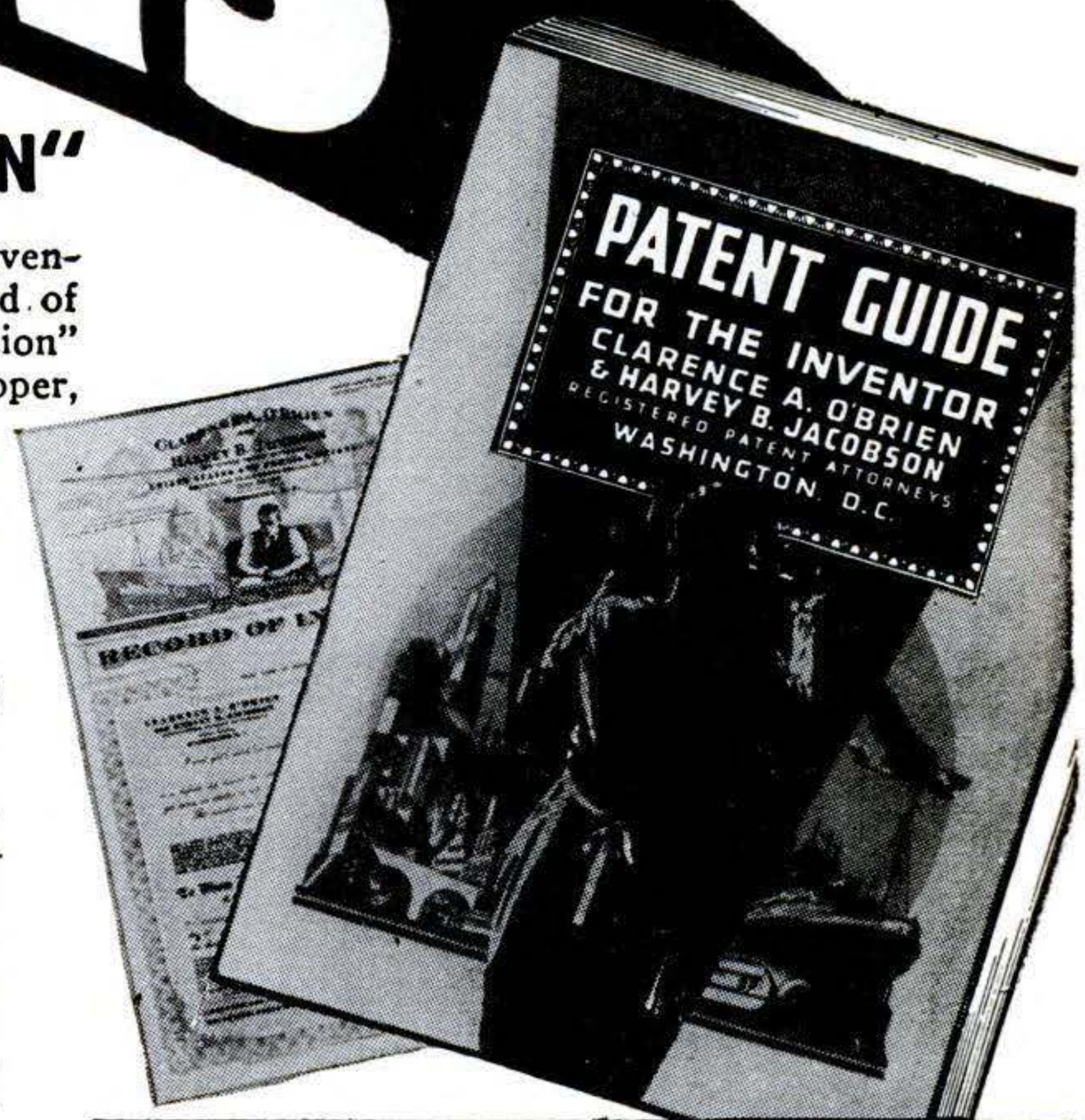

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Jerry, the talking dog, is entertaining hospitalized veterans, by courtesy of the PYROIL Company.

LETTERS

Telewire

Sir:
We have wire-recording phonographs. Why don't we have wire-recording cameras? The picture, in motion, would be taken with a television sending set and recorded. Then it would be projected with a television receiving set. Any bad shots could be erased.

GERALD BAKER

Cresco, Iowa.

It is practically possible; PSM will report when it is practical.

Pu

Sir:
On page 70 of your October issue I find an error in the bottom illustration, southeast corner. The legend says "Plutonium (Pt-239)." Pt is the symbol for platinum; plutonium is Pu.

MAURICE DAVIDSON

Detroit, Mich.

PSM's Department of Grammar, Spelling, and Atomics takes a blush.

Photodimmers

Sir:
To prevent accidents resulting from undimmed motor headlights, I suggest a photoelectric cell behind the radiator, properly connected to the lamps. Beams from the lights of oncoming cars would automatically dim dazzling headlights.

ALLEN BRUCE

Shelburne, N.S., Canada.

Campaign Bars; Battle Stars

Sir:
In PSM, November 1945, Lt. Frank J. Savage's picture said he had been in four major battles, indicated by little bronze stars on the ribbons he wore. You made a slight mistake; he had been in six major battles, because there are four stars on his Asiatic-Pacific campaign bar and two on his Philippine Liberation bar.

M. T. D.

Clinton, Mass.

As explained at the time, two of the stars on his Asiatic-Pacific ribbon represented the same engagements as the two stars that the lieutenant wore on his Philippine Liberation ribbon.

(Continued on page 18)

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LETTERS

(Continued from page 16)

Breathless Rockets

Sir:

You made the statement that a rocket will travel through a vacuum faster than it can travel through the atmosphere. I'm sure that a rocket through a vacuum would not travel anywhere. Without oxygen there could be no combustion.

GERARD J. VOSBURGH

New York City.

Like small-arms cartridges, big-gun shells, or dynamite, rockets carry their own oxygen. Absence of air means only less friction, more speed.

War and Peace

Sir:

Maj. George Fielding Eliot, in his article "Compulsory Training Is Vital," is illogical; his statement that the only way peace has been kept is through force is ridiculous. Peace has never been kept, and wars have always bred wars. History has proved that when militarism has taken over a country, that country is doomed to one war after another until it finally succumbs. Our country has taken many steps along that path; only strong free men can pull it back up the grade.

HERBERT BUELTEMAN, JR.

Zigzag, Ore.

How strong? Does weakness breed strength or freedom?

Cyclotron Champion

Sir:

I believe that the destruction of the Japanese cyclotrons served no useful purpose. It was an act of vandalism comparable to the burning of libraries and the destruction of works of art and cathedrals.

HAROLD C. UREY

Washington, D. C.

Thanks to Professor Urey (Nobel prize-winner and new head of U. S. atomic research) and other forward-looking scientists, PSM has sound support for its beliefs expressed on page 65, January.

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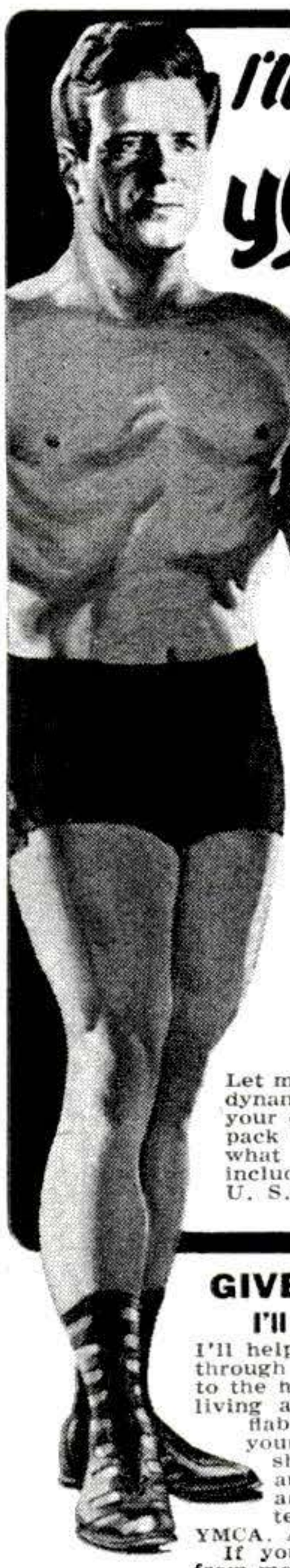

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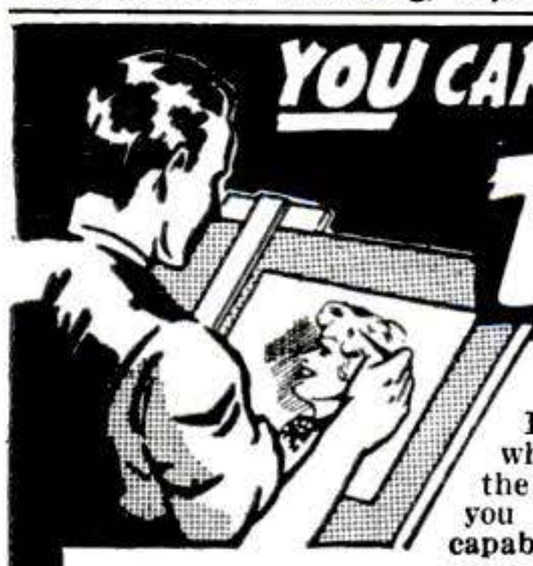

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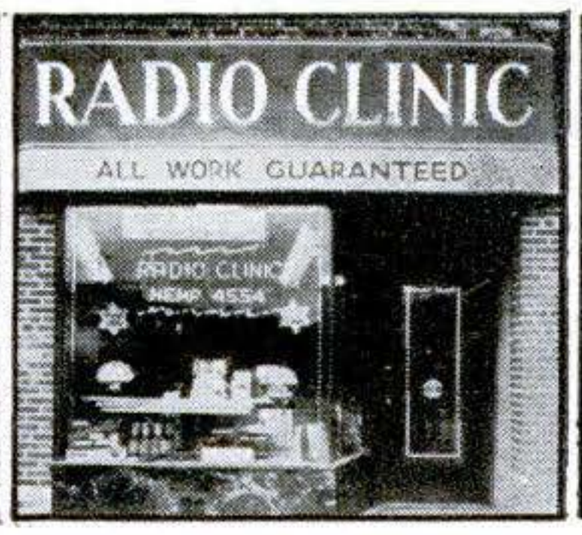

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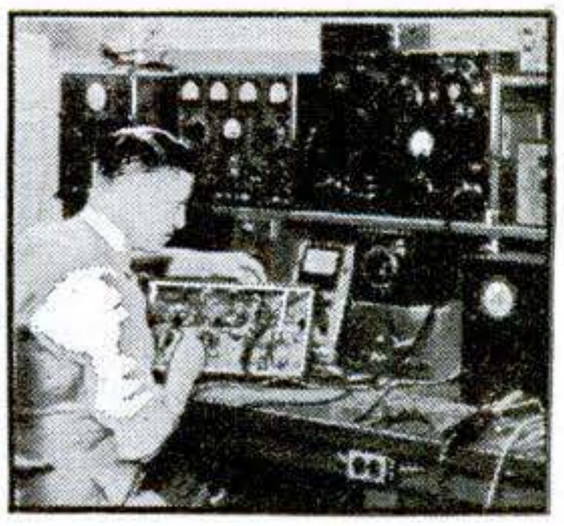

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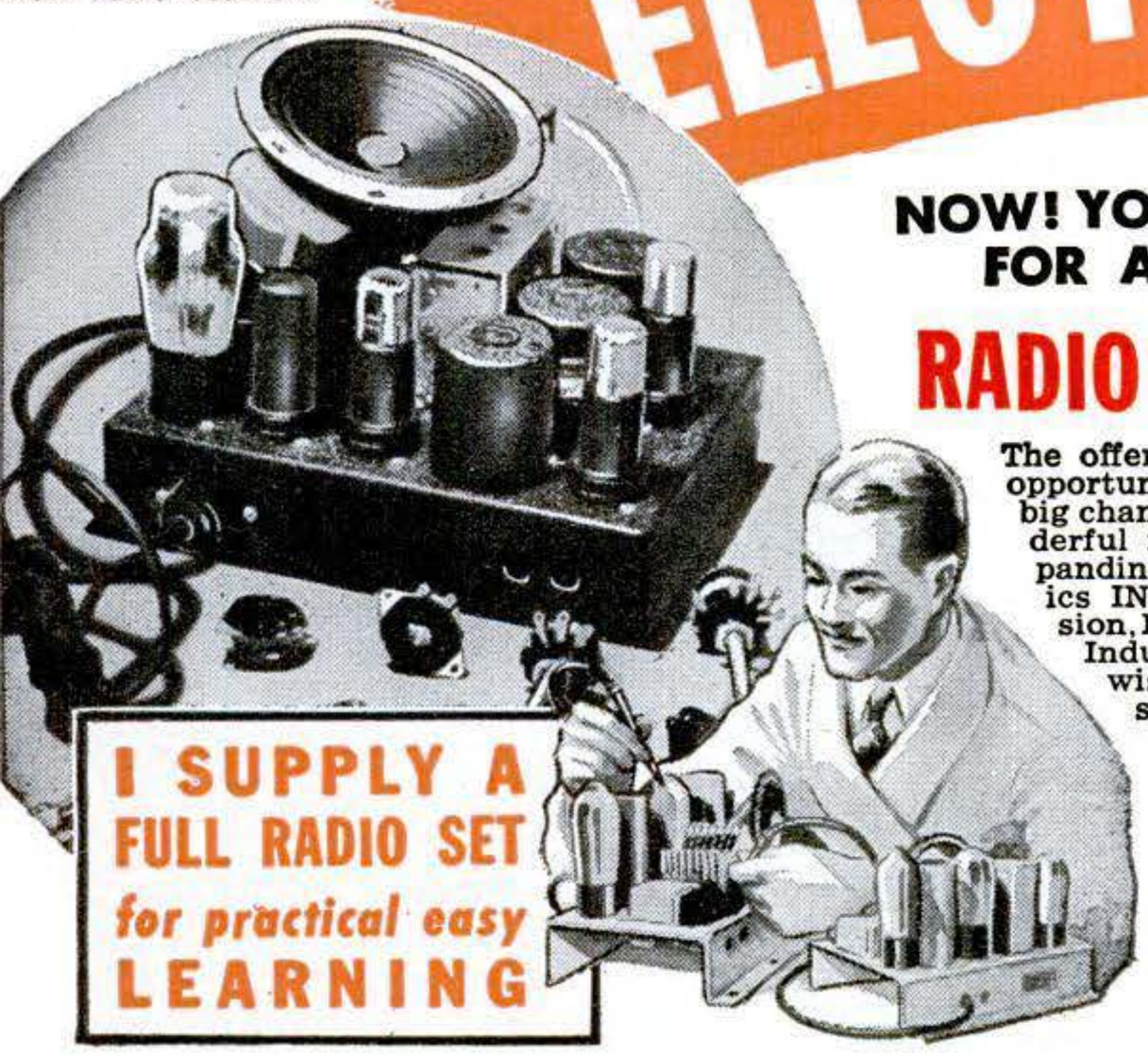

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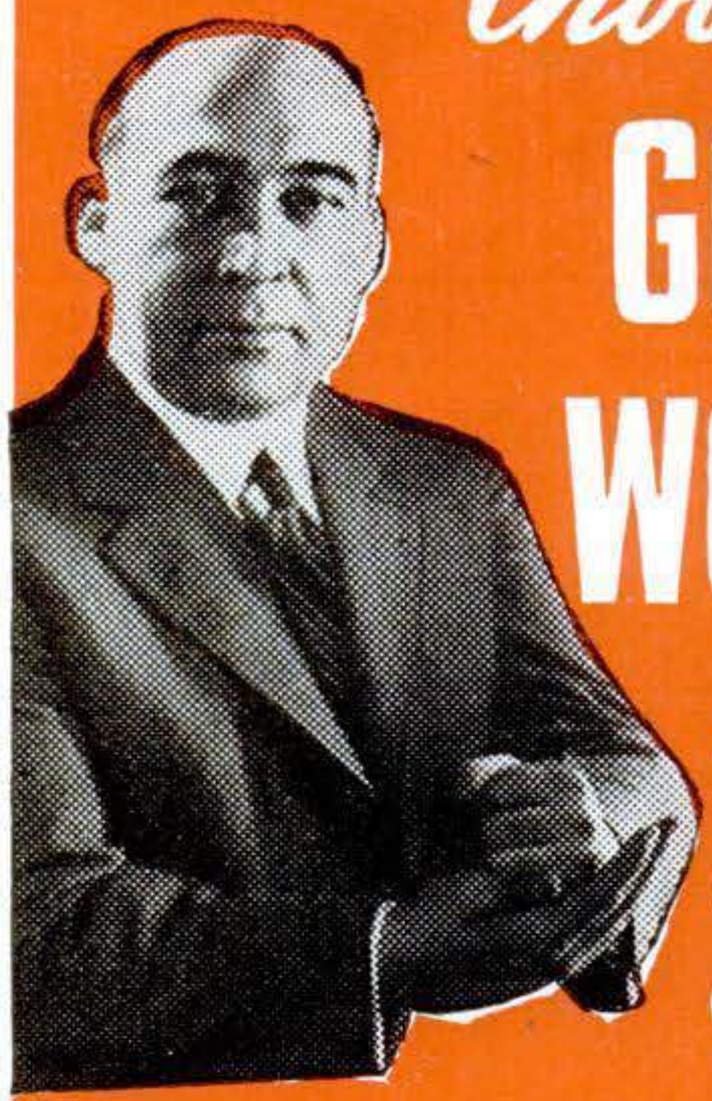

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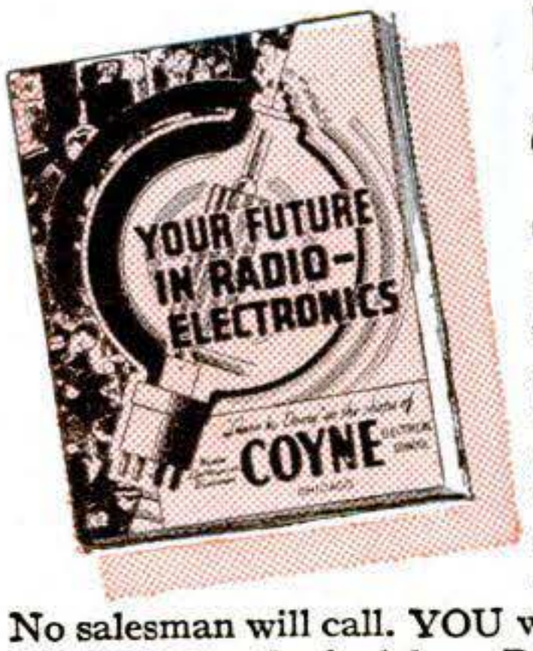

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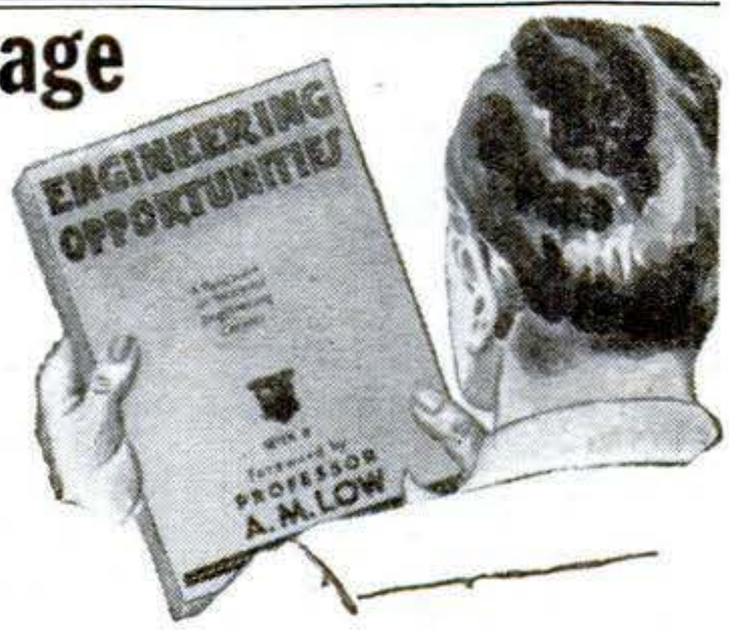

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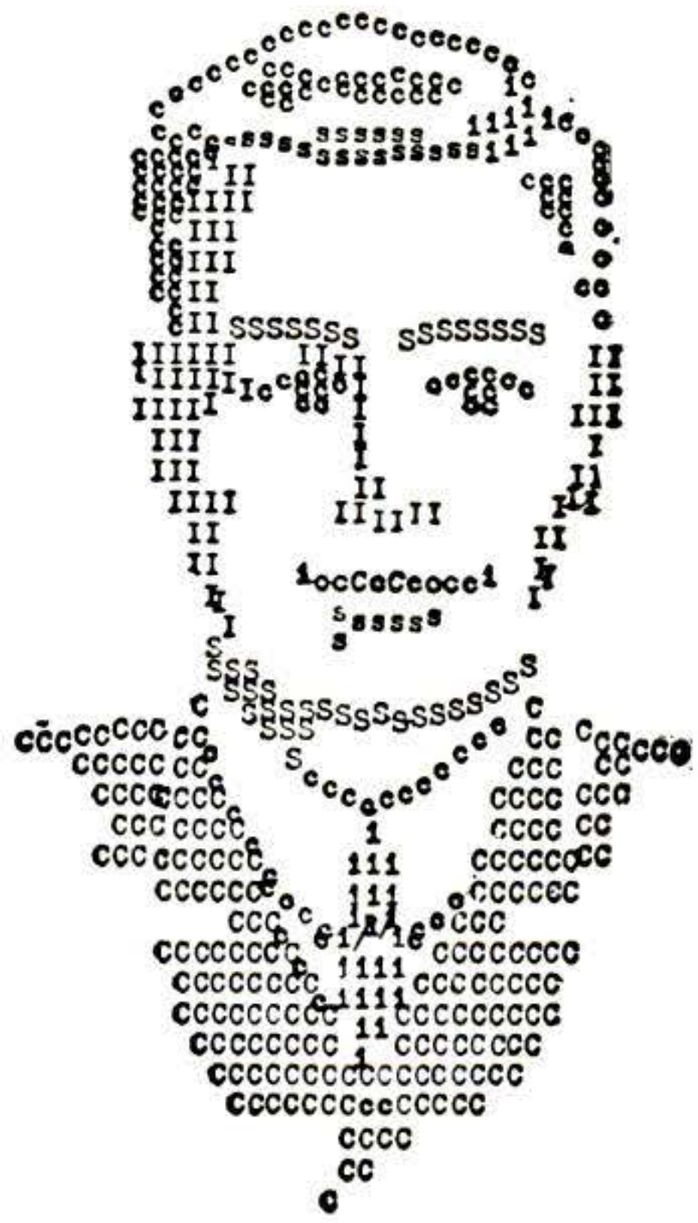

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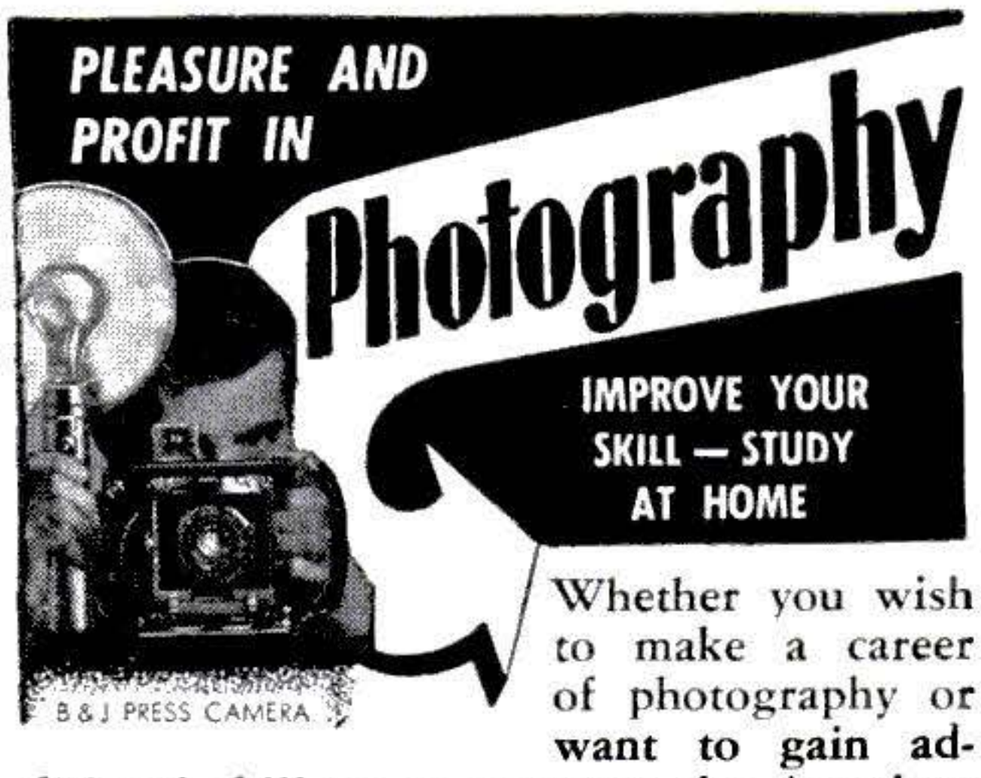

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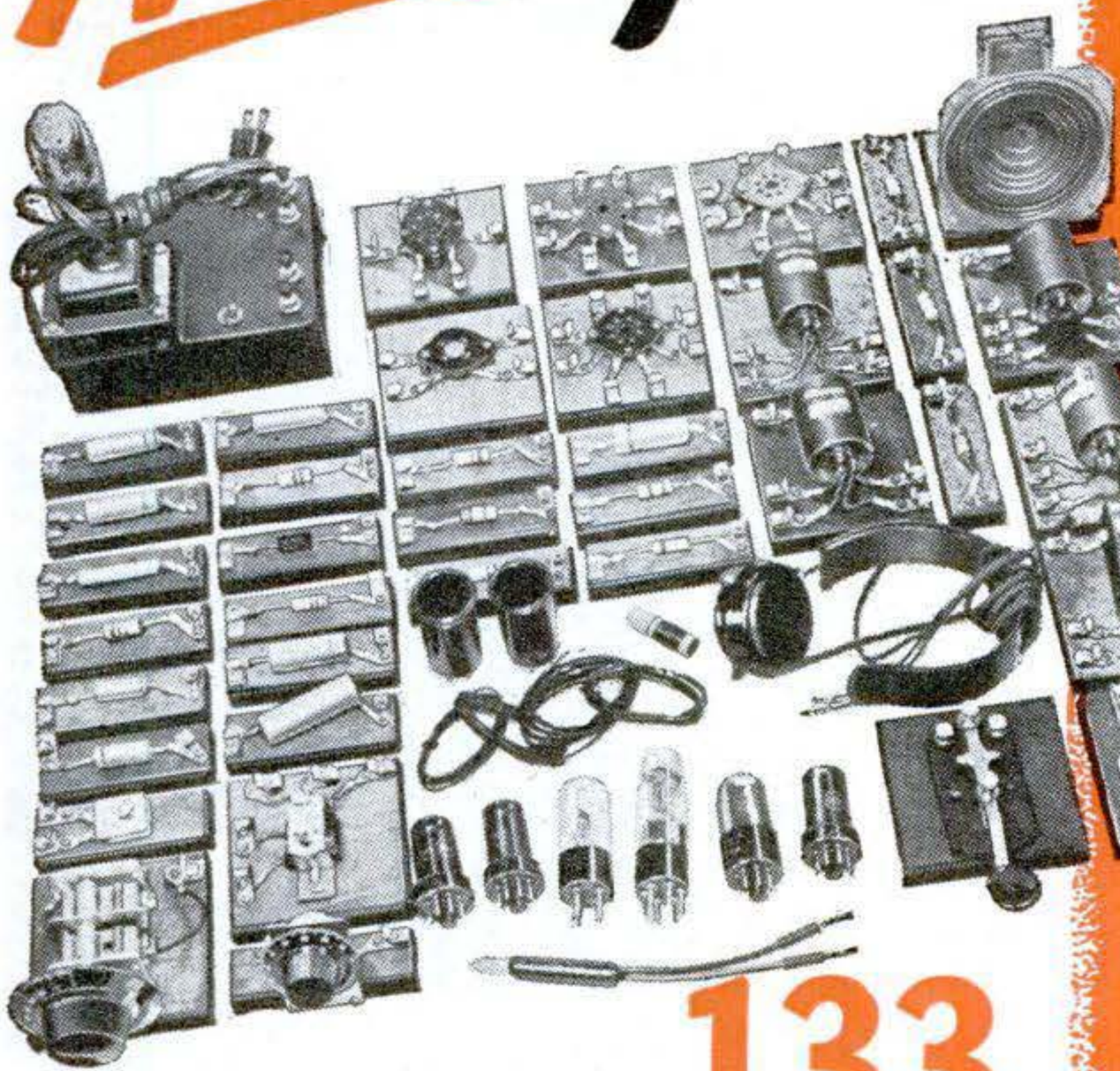

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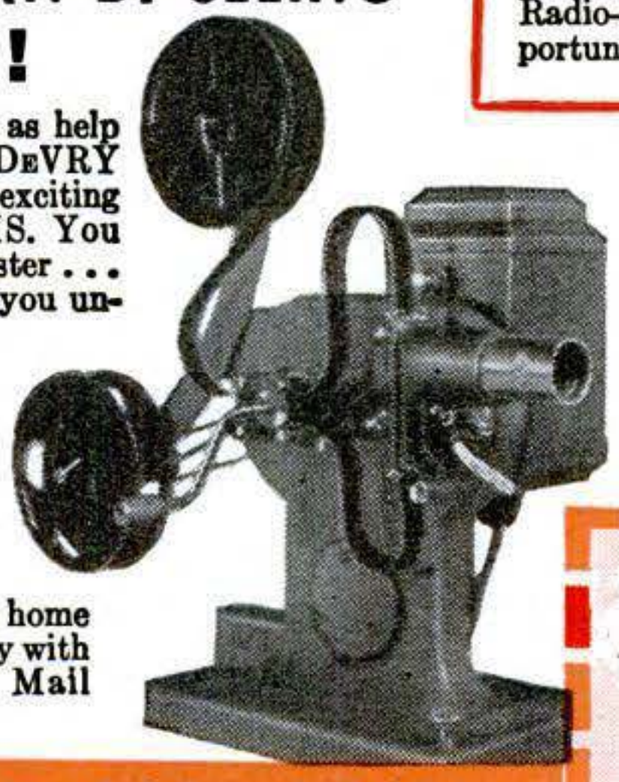

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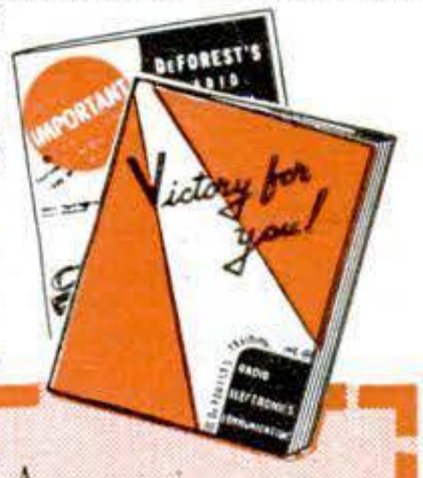

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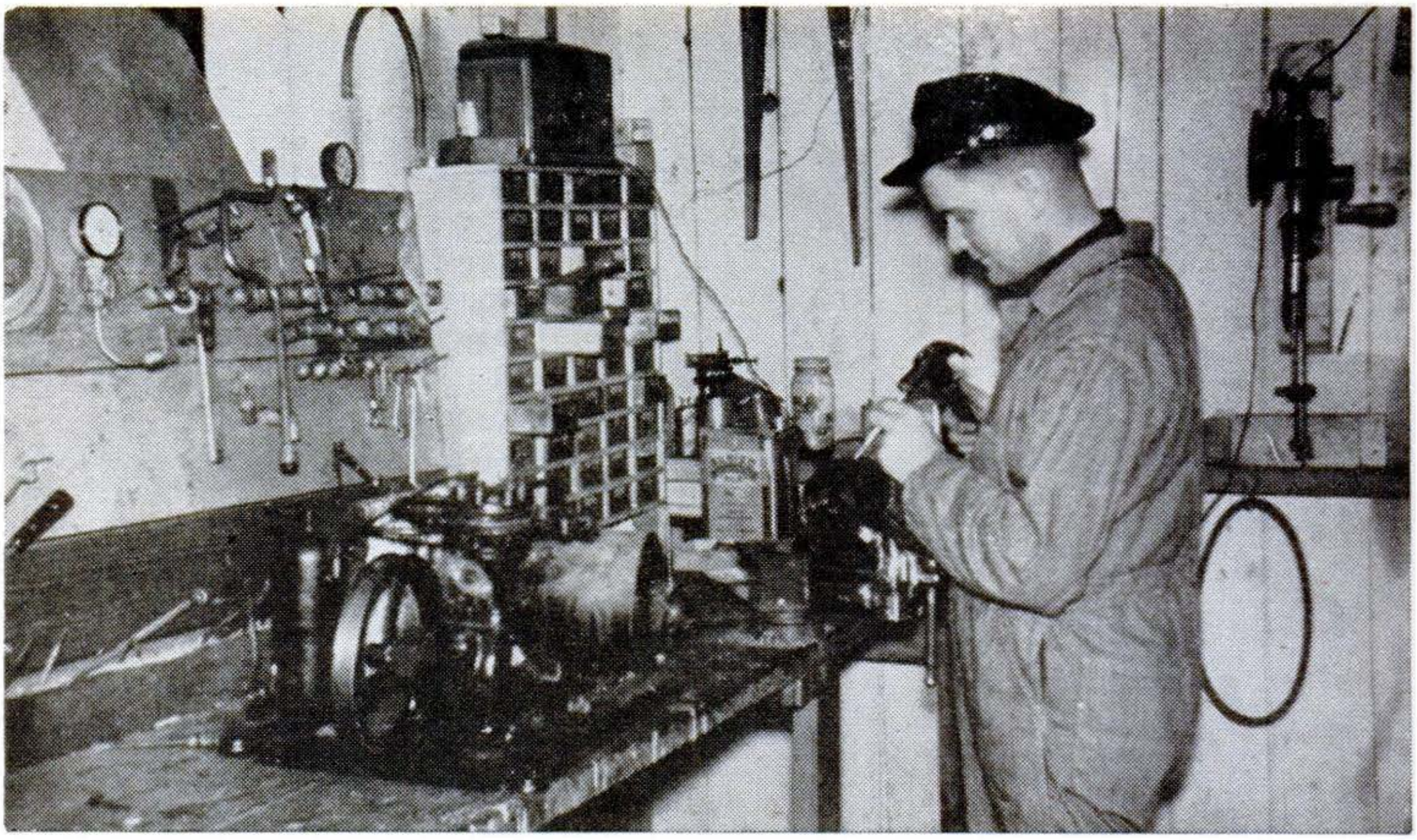

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By S. T. CHRISTENSEN

the "Fix-it Man"

"WELL, I guess I'm the fellow to see, for I've repaired thousands of refrigerators (home and commercial both), vacuum cleaners, radios, washing machines, irons, fans, lamps, mangles, motors, etc. In fact, many of my customers call me their "electrical appliance doctor." And "doctoring," I might add has paid me a good substantial income for quite a few years. Funny, in a way, how I got started. Always liked to tinker and by experimenting around I found that most electrical appliances had many things in common. That, regardless of what the appliance was used for, or who the manufacturer was, the basic principles were much the same. From fixing my own appliances to fixing friends' and then for strangers at a fee, seems now to have been but a small step.

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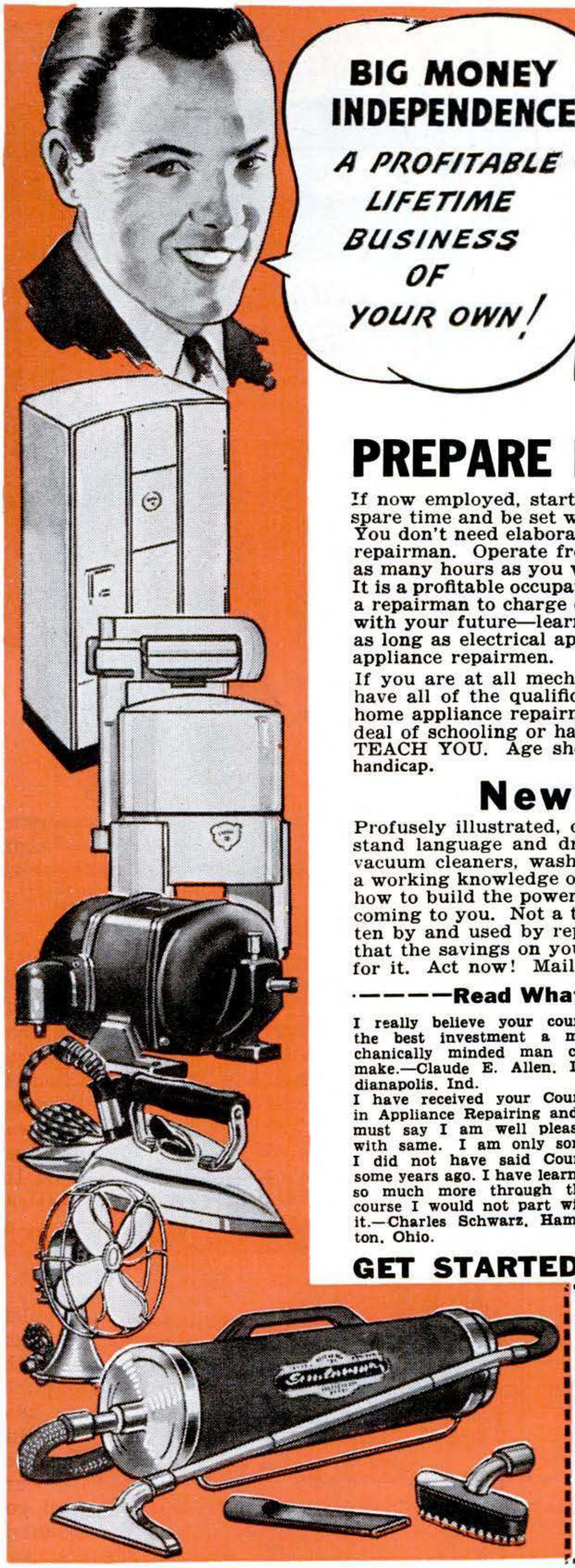

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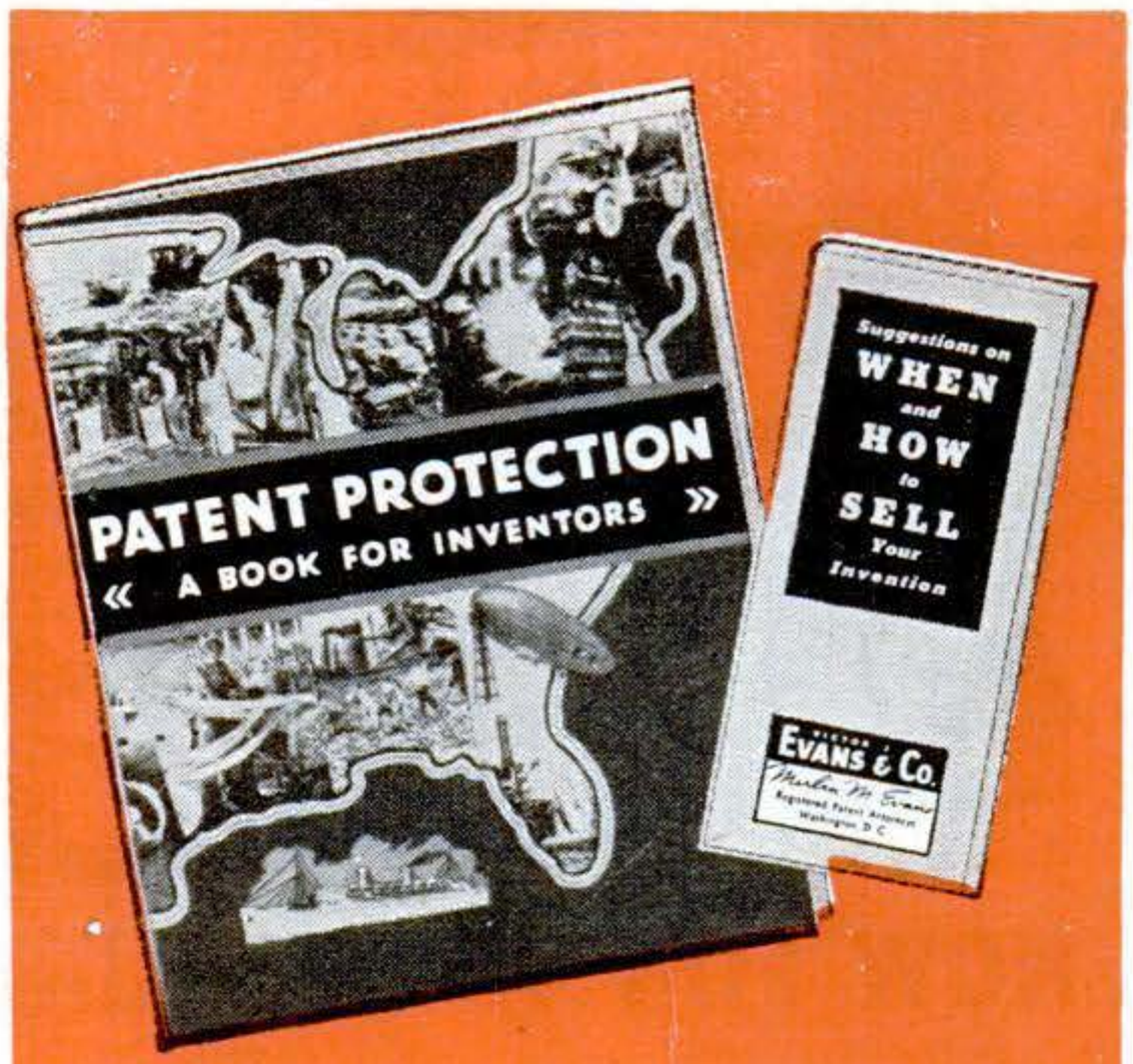

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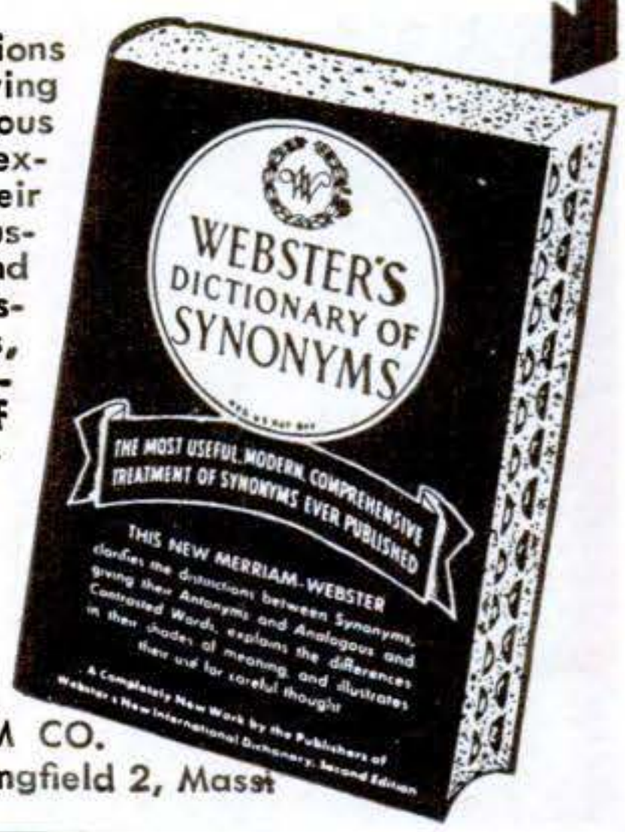

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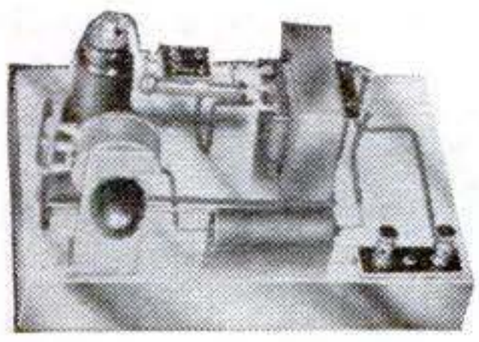

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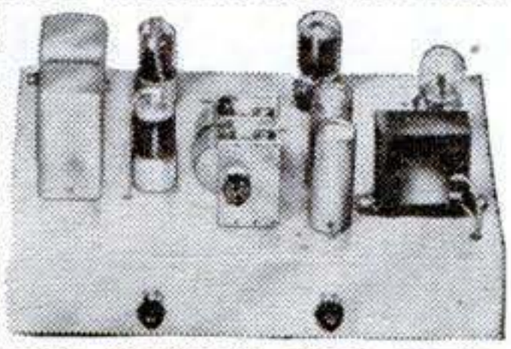

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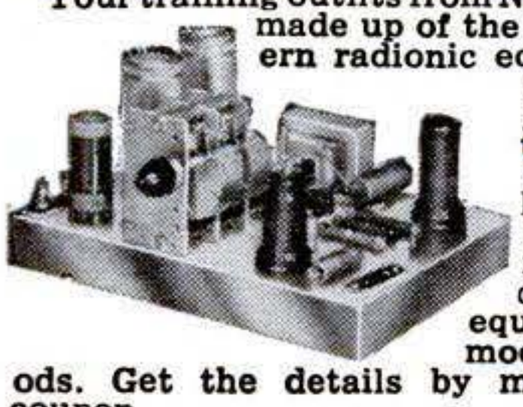

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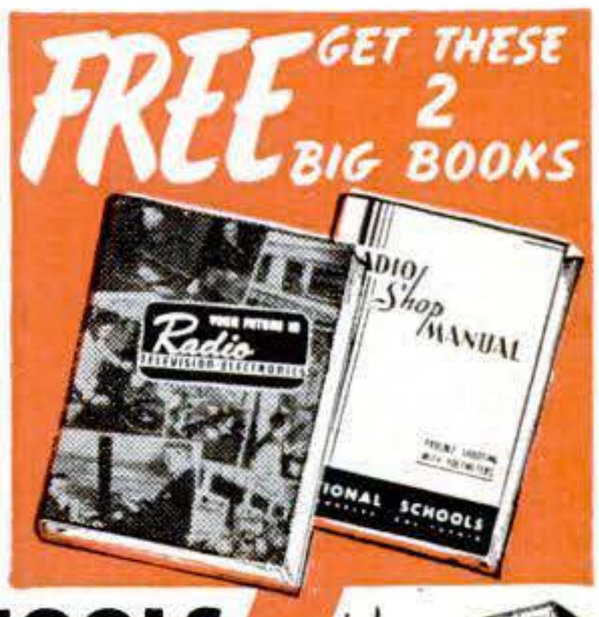

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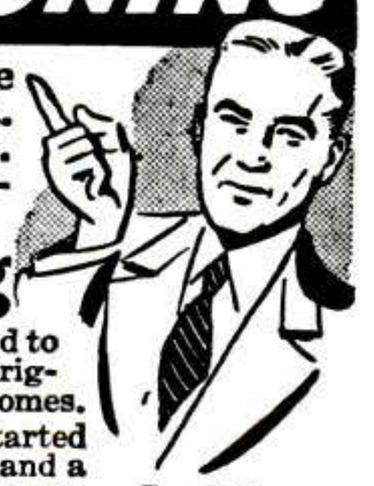

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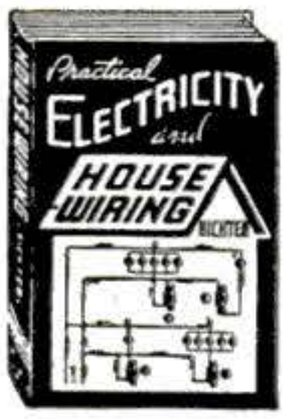

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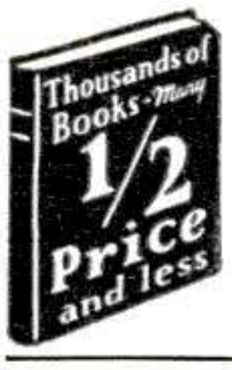

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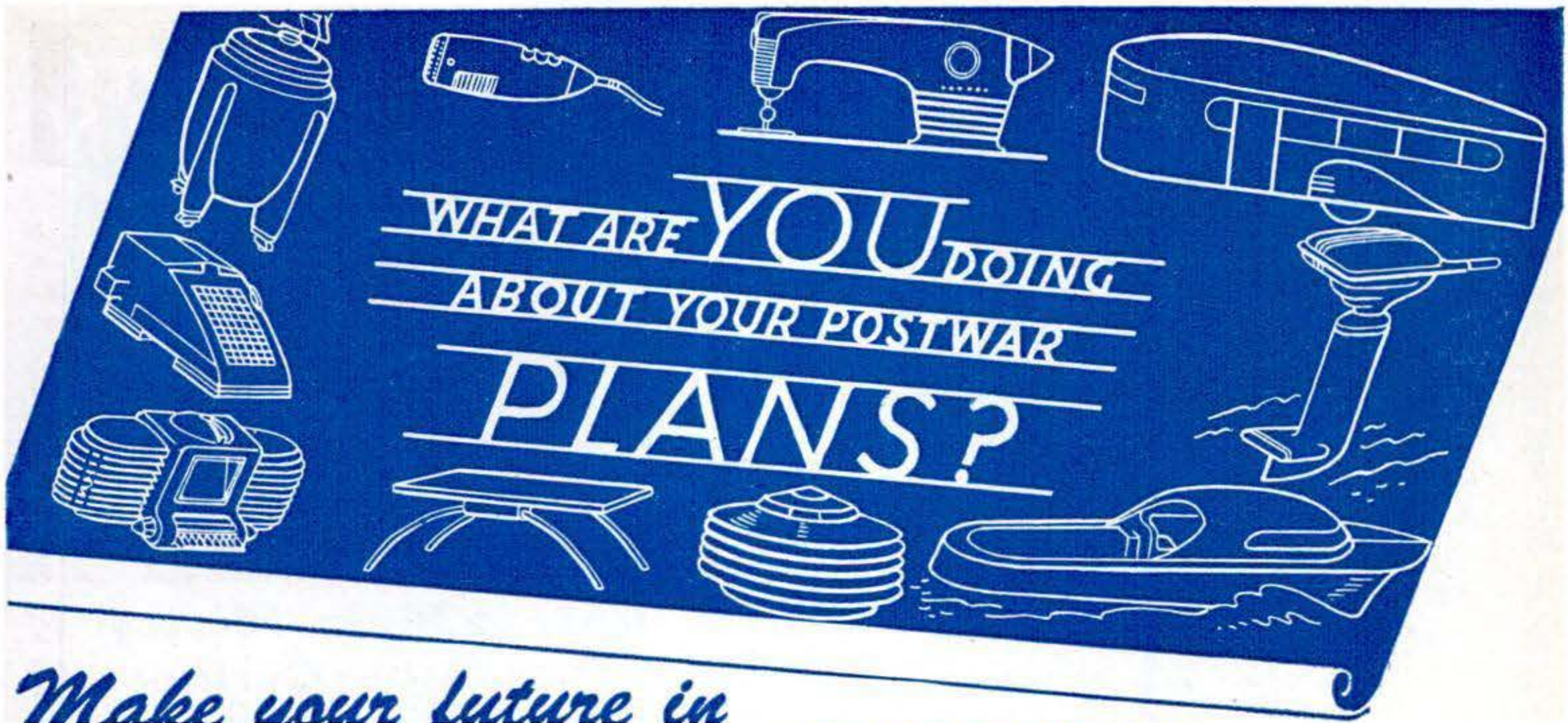

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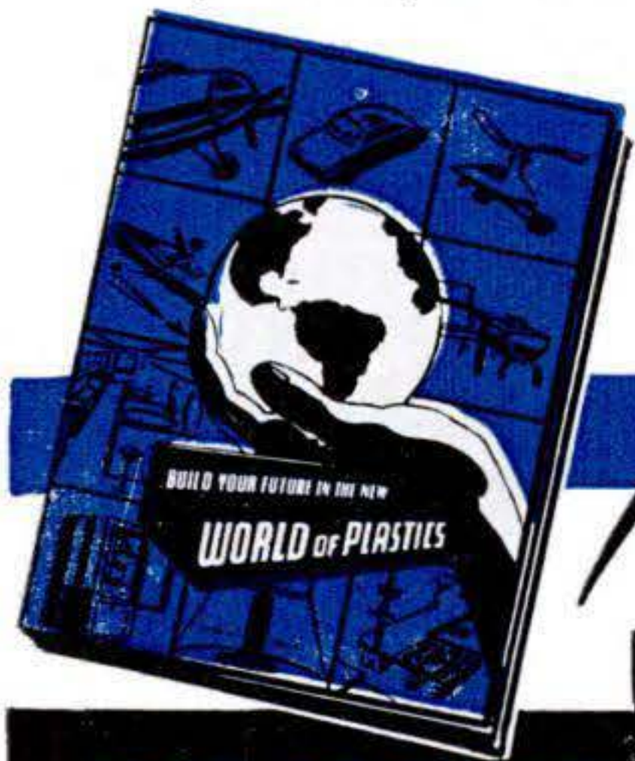

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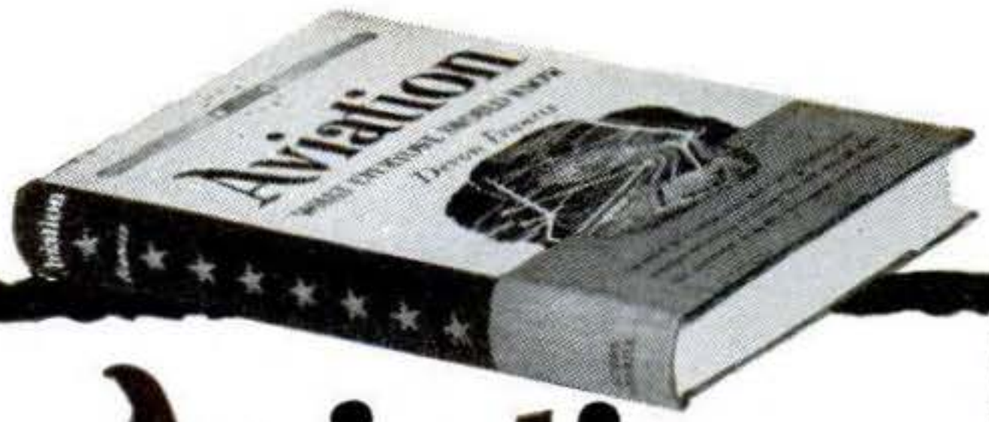

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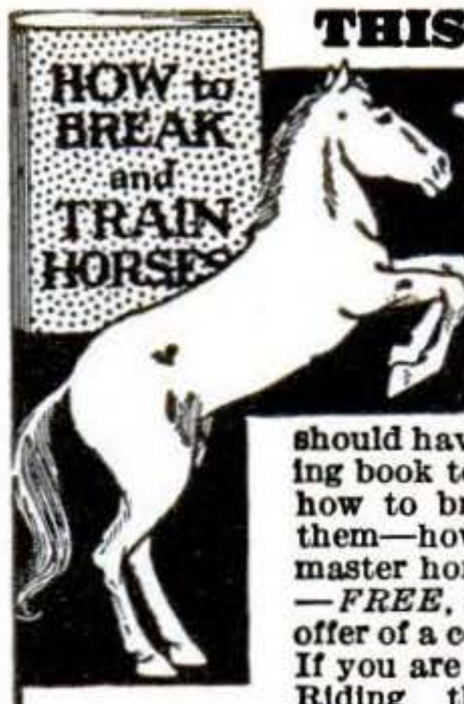

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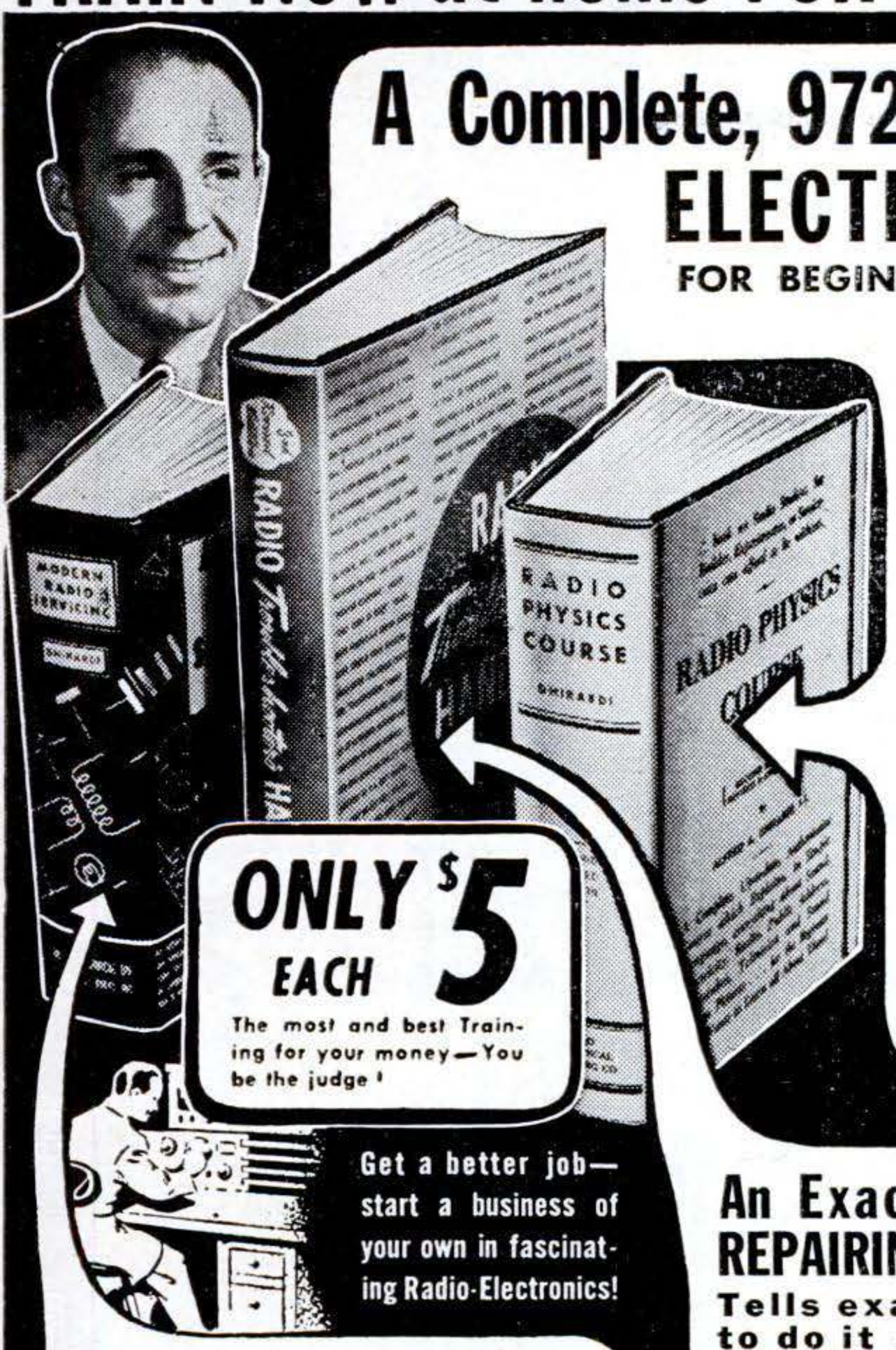

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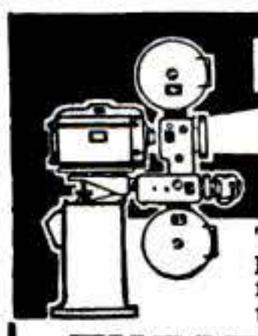

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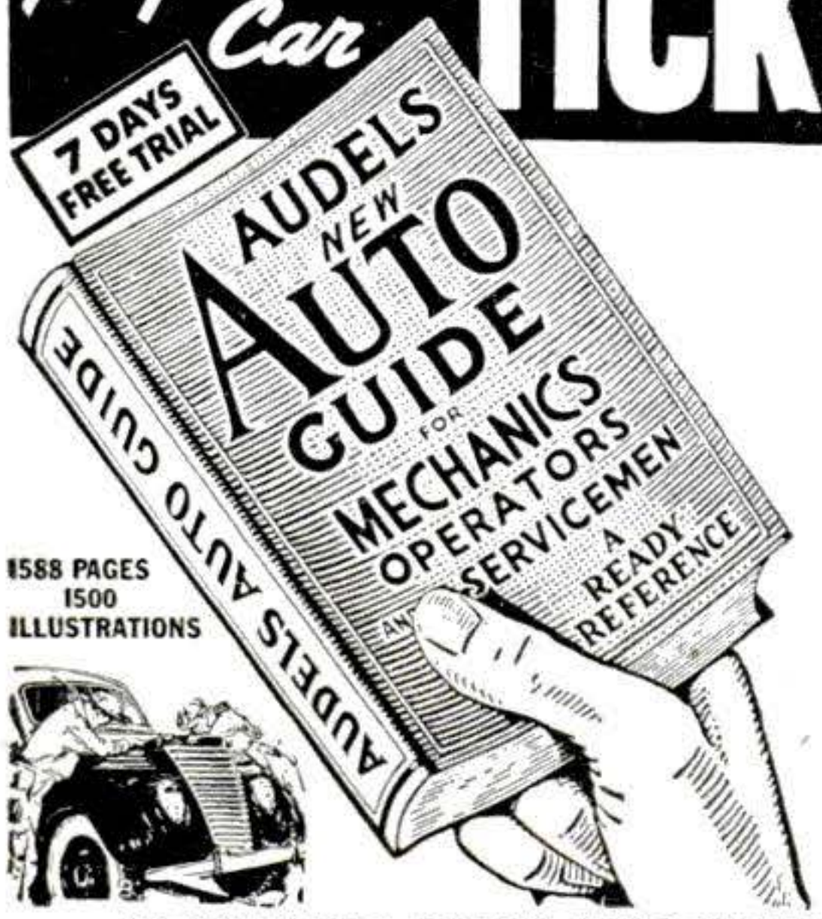

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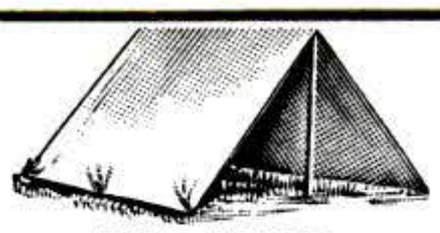
U.S. Gov't BOLO KNIFE

Extra heavy. For farm, home or jungle use. Blade of gov't. formula cutlery steel. Walnut riveted handle, 3½ inch hilt, 10½ inch blade. You'll find hundreds of uses for a Bolo knife. Blade will take and hold a keen cutting edge. Weight 2 lbs.

A-112 with Army Sheath . **$4.95**

A212—Leather Sheath, extra **$1.50**



PUP TENTS

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, boy scouts, etc. Grand Xmas gift for children. Wgt. 5 lbs.

A-100 Tent only **$4.95**

A-110 Tent. New **$7.95**

A-101 Ropes, wooden poles and stakes for above. Per set. . . . **$1.00**

SHIPS BELLS

Purchased from U. S. Maritime Comm. Measures 10 inches high, 9¾ inch flare. Big 6 inch clapper. Weight 15 lbs. Fine for farms, clubs, estates, etc. All new

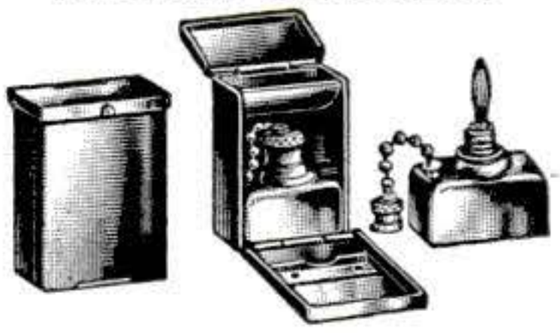
A-541, ONLY **$9.85**

PROF. TELEGRAPH KEY

Purchased from the gov't. Finest design and construction. Base measures 3x4¾ inches. Original value $2.50. All parts of instrument brass. Adjustable.

A147—Each . . . **98c**

MEDICAL STERILIZER



Consists of alcohol burner and sterilizing tray in hinged metal case 1⅞ x 1⅛ x 2⅝ inches. Burner may be used separately. Bright nickel finish. All brand new. Shp. wgt. 1 lb.

A125—EACH **98c**

MESS KITS

Regulation Army Mess Kits. Ideal for campers, boy scouts, etc. Slightly used but guaranteed perfect. Two pieces. Folding handle.

A116—EACH **69c**

Regular U. S. Gov't issue canteens. Plastic screw top cap chained to body. Slightly used. **A117**—METAL BODY. Each. **69c**

A118—PLASTIC BODY. Each. **69c**

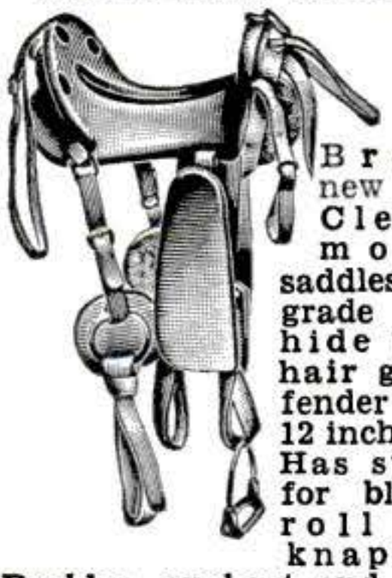
A109—Canteen Covers, new, Ea. **69c**

A119—Canteen Covers, used, Ea. **35c**

A120—Canteen Cups, used, Ea. **25c**

WAR SURPLUS AND HUNDREDS OF OTHER BARGAINS

McCLELLAN SADDLE



Brand new McClellan model saddles. Top grade cowhide with hair girth, fender and 12 inch seat. Has straps for blanket roll and knapsack. Buckles, gunboat and sabre loops. A splendid value. Shp. wght. 10 lbs.

A145—EACH **$13.95**

27 LENSES, ALL NEW, PERFECT

For experimental work in optics. Consists of 27 precision ground and polished prisms and lens elements in assorted diameters and focal lengths. Big variety, positives, negatives, etc. Actual value over $100.00.

A519—27 PIECES **$7.95**

50 LENSES, SEMI-FINISHED

Lenses similar to above but not polished. All are blanked and formed ready for polishing. Negatives, positives, and prisms in Crown and Flint glass. Worth many times this low price.

A520—50 LENSES, ONLY **$1.95**

RADIO HEAD-PHONES

Extremely sensitive with 4000 ohms resistance. Brand new and fully guaranteed. With moisture-proof cord and phone plug. A splendid value for the radio serviceman and experimenter.

A106—PAIR **$2.95**

New supersensitive phones. **A108**—Pair **$5.95**

7-LB. RADIO PARTS ASSORTMENT

A "gold mine" for the radio serviceman. Hundreds of valuable radio, radar and electronic parts, including individual parts, subassemblies, etc. Worth many times this low price.

A130R—7 LBS.

$1.79

G I BELTS

Of heavy canvas webbing. Adjustable in size. Snap-on buckle. Eyelets all around. Used, but guaranteed.

A107—EACH **98c**

SADDLE BAGS

Made of finest top grain leather. Rivet reinforced seams. Bottom and side gussets. Each canvas lined bag measures 12x13 inches. Fine for motorcyclists. May be separated to make two duffle bags. Used, but perfect.

A151—EACH **$7.95**

PLASTICS

LUCITE AND PLEXIGLASS

In sheet form. Good workable sizes. Transparent. For costume jewelry, etc. Easy to work and polish.

A280—5 LB. ASST. **$4.75**

CATALAN—ASST. COLORS

Extruded shapes, rounds, half rounds, etc. Easy to machine. Furnished in assorted colors, shapes and lengths.

A281—5 LB. ASST. **$4.75**

MICROPHONE BUTTON

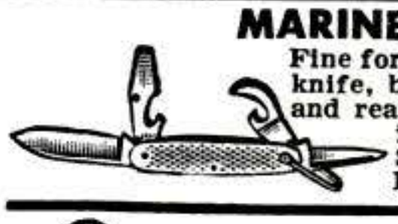
Brand new! For experiments in radio, electronics and other electrical apparatus. Used in telephone, amplifier and detectaphone work. Diameter 2½ inches. New. Shp. Wgt. 1 lb. **A512**—Each **98c**

AMMUNITION BOX

Fine for storing valuables, carrying lunches, etc. Of heavy gauge metal 7½x11x4 inches. Fireproof. Hinged lid with folding handle. Olive drab finish. Used, but perfect. A splendid value.

A-525 Each **25c**

MARINE KNIFE

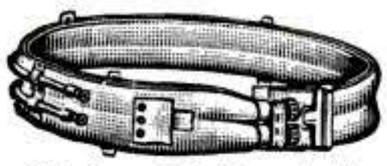


Fine for boy scouts. Blades include knife, bottle opener, screw driver and reamer. All metal handle 3¾ inches long. Wght. 1 lb. Stock No. **107** EACH **$1.95**

WATCH COMPASS

Officer's type. Brand new gov't surplus. Army-Navy model. Single jewel mounted needle. Silver colored dial. A splendid value. Wght. ½ lb. Stock No. **A-174** EACH **$2.35**

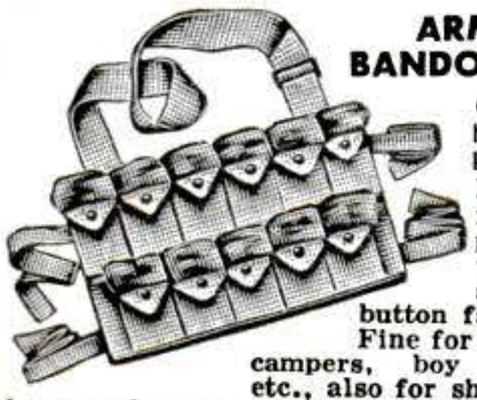
LIFE PRESERVER BELTS



Right from the invasion beaches. Consists of two air chambers. May be inflated automatically with 'sparklet' cartridges or manually by attached hose. Adjustable in waist size. One air chamber guaranteed air tight—other may need a tire patch. All belts are used and slightly soiled but a bargain at this low price.

No. **1261**—EACH **$1.00**

ARMY BANDOLEERS



Of fine heavy khaki. Big roomy pockets with snap button fasteners. Fine for hunters, campers, boy scouts, etc., also for shop work in carrying small parts, etc. Material alone is worth this price.

11 Pocket Type No. **129** EACH **49c** | 5 Pocket Type No. **110** EACH **29c**

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Values galore! Hundreds of hard-to-find items for home, shop and outdoors. Make remittances by money-order, bank draft or personal check. Send 25% deposit on C.O.D. orders. No C.O.D.'s on orders for less than $5.00. Include sufficient postage on parcel-post orders—any overage will be promptly refunded. All quotations F.O.B. Chicago. Used items and materials are guaranteed serviceable and as described. Your money back if not more than satisfied.

BIG ILLUSTRATED CATALOG FREE

STARK'S

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509 So. State St.
CHICAGO 5, ILL.

STILLS

Distill your own water with one of these fine portable stills. Purchased from the Gov't. Completely self contained. Has 1 gallon capacity—output 1½ gal. per hour. Fitted with genuine Coleman double burner stove. Operates 5 to 7 hours on one filling. Heat output 20,000 BTU's Stove alone is worth this price. All new and guaranteed. Instr. included. Wght. 109 lbs.

No. 206—EACH

$59.50

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ADVERTISE 24 words. 40 Newspapers $3.50. List Free. Advertising Bureau, 4515-P Cottage Grove, Chicago 15.

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ADVERTISING: Placed in any publication, anywhere. Write for Mail-Order rate folder "P". LeGrand Adv. Agcy., (Established 1923) Floral Park, N. Y.

SALES Letters by former Assistant Director of Correspondence at Sears Roebuck and Co. Write fully. Director, 1832 Stanwood St., Phila. 15, Penna.

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TRADE Magazine Directory. See Books, Periodicals. Commercial Engraving Publishing Co.

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INDUSTRIAL advertising that gets results. Present advertising analyzed for small fee. 25 years experience. L. S. Van Denburgh, Box 201, Newark 1, New Jersey.

SALES Letters—We'll write you a dynamic sales-producing sales letter for only $5. Just tell us your proposition. Business Consultants, 28 E. First, Hutchinson, Kansas.

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DRUNKENNESS Is a disease which responds to treatment. Medical skill plus human sympathy prove successful with liquor and drug cases. 60 years experience. Write for free booklet. P. S. Nelson, The Keeley Institute, Dwight, Ill.

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LICK After-war layoffs; Start own business; home, office. Booklet describing "Collection of 127 Tested Plans" free. Elite Co., 214A Grand St., New York.

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START Your Own Business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world wide Industry. Write Rawleigh Co., Dept. B-U-PSC Freeport, Ill.

WAR Honor Scroll. All branches of service represented. 12 by 16. Space provided for name and photograph. Truly beautiful. Agents make big money. Sample 25c. E. Condon, Dept. 9, Upper Darby, Pa.

AMAZING New Zipper Shoe sells on sight. Big profits for salesmen. Leads line 200 splendid styles. Territories open. Get Free Sample Outfit. Write Consolidated Shoe, Dept S-153, Chippewa Falls, Wis.

CALL On Friends with Greeting Card Assortments; Easter, Birthday, other occasions. Personal Stationery; Gift Wrappings. Big profits. Experience unnecessary. Samples on approval. Wallace Brown, 225 Fifth Ave., Dept. B-4, New York 10.

BEAUTIFUL Gold Embossed Honor Scroll for Veterans. Most beautiful service memento Anywhere, regardless of price. Sells on sight for $1.00—Up to 85c profit to agents. Three saleable samples $1.00 postpaid. Particulars Free! Levine's, Box 15-A, Boulevard Station, New York 59, N.Y.

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SELL Greeting Cards. Easy Money showing gorgeous All Occasion, Birthday, Religious, Humorous, Valentine, Easter Box assortments. Wrappings, Stationery, Correspondence Notes. Special Offers. Experience unnecessary. Quick service. Request $1.00 Everyday Assortment on approval. Hedenkamp, 343 Broadway, Dept. PSF, New York 13, N. Y.

90c PROFIT each $1 sale. Sell permanent mothproofing solution to housewives, stores, agents. Experience unnecessary. Postal brings details. Kinford, Wayne 4, Penna.

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SCHOOL Seniors! A Postal Will Bring You Our Kwick-Sell Cardalog of graduation name cards. Hot selling everywhere! Big profits! Hurry! Craftcards, Box 235 (M), Pittsburgh 30, Pa.

SELL "Petite Picture Notes." Something really different in greeting cards. Sample free. Dunbar Cards, New Brunswick 21, N. J.

$1 STARTS you in business. Sell Deluxe five fold ties, 100% wool interlining. Costs you only $7 per dozen, you make $5.00 dozen. Send $1.00 for special introductory offer two five fold ties. Catalog complete line Free. Philip's Neckwear, 20 W. 22nd St., Dept. K-50, New York 10.

AGENTS Wanted. Retail 5c item everyone buys and buys again. Details Free. R. Birchard, 244 W. 101st St., New York City.

SELL Spac-Saver clothes rack for closets. Fifty-two inches hanging space on twenty-two inches. H. & H. Products Co., Arkansas City, Kansas.

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UP to 100% profit selling friends sensational $1.00 All Occasion greeting card assortment. Costs you 50c up. Birthday, Baby, Gift Wrapping, Humorous, Scripture boxes 35c up. Extra bonus. Request $1.00 box on approval, free personal stationery portfolio. Special Offer. Elmira Greeting Card Co., M-57, Elmira, N. Y.

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MAGIC cleaner and laundry soap deal. Hotter than a firecracker. Big profits. Sample Free. Uco, 5007 Irving Park, Chicago.

NEW year 'round extra money plan. Show friends exclusive greeting card assortments. Up to 100% profit. Request All Occasion $1.00 assortment on approval. Also show Birthdays, Social Notes, Gift Wrappings. Free Sample Personalized Stationery. Thomas Terry Studios, 28 Union Ave., Westfield, Mass.

SCHOOL Seniors: Sell classmates superb Craftcards for super profits. Write Craftcards, Box 235 (AH), Pittsburgh, Pa.

WE pay you $25 for selling fifty $1.00 assortments Birthday, All Occasion cards. Tremendous demand. Sell for $1.00—your profit 50c. It costs nothing to try. Write for samples. Cheerful Card Co., 58 White Plains, N. Y.

AGENTS—to sell new wrinkle yielding preparation—pure—guaranteed or money refunded—4 oz. $2.50. Mrs. Leonard Butler, Havana, Fla.

HAVE You received our offers, write, Box 61, Times Square Station, New York City 18.

200 MONEY Making Plans. Formulas, Schemes. Folio Free. Formico Service, Box 572, Dayton, Ohio.

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BUILD Year Round Lifetime Business, sell everyday necessities to stores, institutions, industrial plants, homes, etc. Easy repeats. Excellent profits. Great cooperation. Become territory distributor. Investigate. Lytle Supply Co., Ave. 12, Fredericksburg, Ohio.

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ENGRAVED Plastic Nameplates protected territories—Big Profits Get Details. Caraday, 489 Fifth Ave., New York 16, N. Y.

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MAN, You'll Like Silvering Mirrors, Reflectors! Plating Tableware. Making Sparkling Chipped Glass Nameplates. Outfit Prices. Sprinkle, Plater, V90, Marion, Indiana.

25c WILL Bring You Hundreds Of Propositions from firms who want agents. Tired of answering ads? Then try our way. Kakay & Co., Box 1032, Tampa 1, Florida

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SILVER Plating Liquid. (NuSilver trade mark). Apply with a cloth. Simply rub-on with a saturated cloth, dry-off and buff-up bright with a dry soft polishing cloth. All done in 1 minute. It cleans, silverplates and polishes from the one application. Easily done at home or in the office by anyone. NuSilver Plating Liquid is a more than 50% (½ plus) genuine U.S. Government Treasury Department Domestic Silver solution, 1000 Fine (pure Silver), Sterling. It renews all Sterling and plated silverware. It also silverplates onto brass, copper, bronze, zinc, nickel-silver, german-silver, and some other composition metals. Over 100 uses listed to date. NuSilver is a permanent lasting finish. Won't wash off. Won't brush off. Won't boil off. Once applied as directed it is there to stay. NuSilver Plating Liquid is a widespread and intensive seller. Working sales distributors are wanted for areas not now being worked. Easily sold to merchants in dozen lots by a sales set-up which furnishes free printed guarantees, printed advertising leaflets and one store counter display card for each one dozen, any kind of a store or business place can sell NuSilver. Any kind of an average distributor-Salesman can sell NuSilver. You sell, deliver and collect your big cash profits as you work. Details by letter-mail. For U.S.A. territory only. Can sell both wholesale and retail, and to jobbers, or any way you like. NuProcess Products Laboratories, Dept. 207, Aurora, Ill.

JIGSAWED Masonite Letters, Windvanes, circular. Stamp. Michael Schumacher, West Hampton Beach, N. Y.

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DEADLY Judo-Fiercest fighting technique. Complete course (200 photographs) special $1.00. Variety House, Box 46-AC, Wall Station, N.Y.C.

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IMMEDIATE Income for Writers, beginners or advanced. Learn how to write and sell short personalized stories. Profitable waiting market. Send stamp for literature and proof. S. Snyder, Box 4907-W, Philadelphia 19, Pa.

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JET impulsion now for automobiles. Rush name for free literature. Wayne Engineering, Greenville 2, Ohio.

NOW Ready! Floyd Clymer's Historical Motor Scrapbook Number Three, entirely different from Editions One and Two. Ads, photos, descriptions, specifications over 200 early autos, including Rolls-Royce, Owen Magnetic, Fordmobile, Revere, Ruxton, Cord, Roamer, Diana, Adler, Mercedes-Benz, Stutz Bearcat, Marmon, Stout, Flint, Lozier; steam and electric cars, many others. Motorcycle section includes early Cleveland, Henderson "6", Peerless, Wagner, Crocker, AMC, BMW, Excelsior, Ariel, Flanders, others. Pike's Peak races, many interesting incidents early automotive days described. Profusely illustrated. Continues Floyd Clymer's interesting autobiography. $1.50 postpaid; De Luxe Clothbound, $2.50. (Editions One and Two also available at these prices.) Clymer, 2125 W. Pico, Los Angeles 6, Calif.

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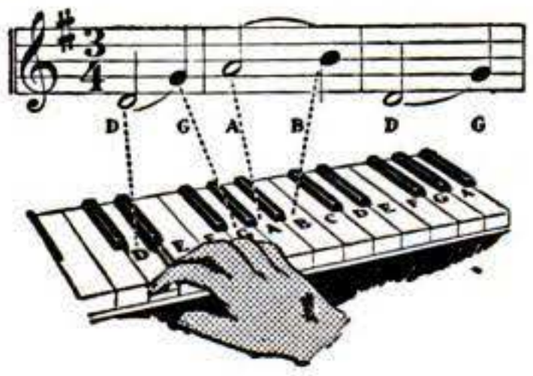

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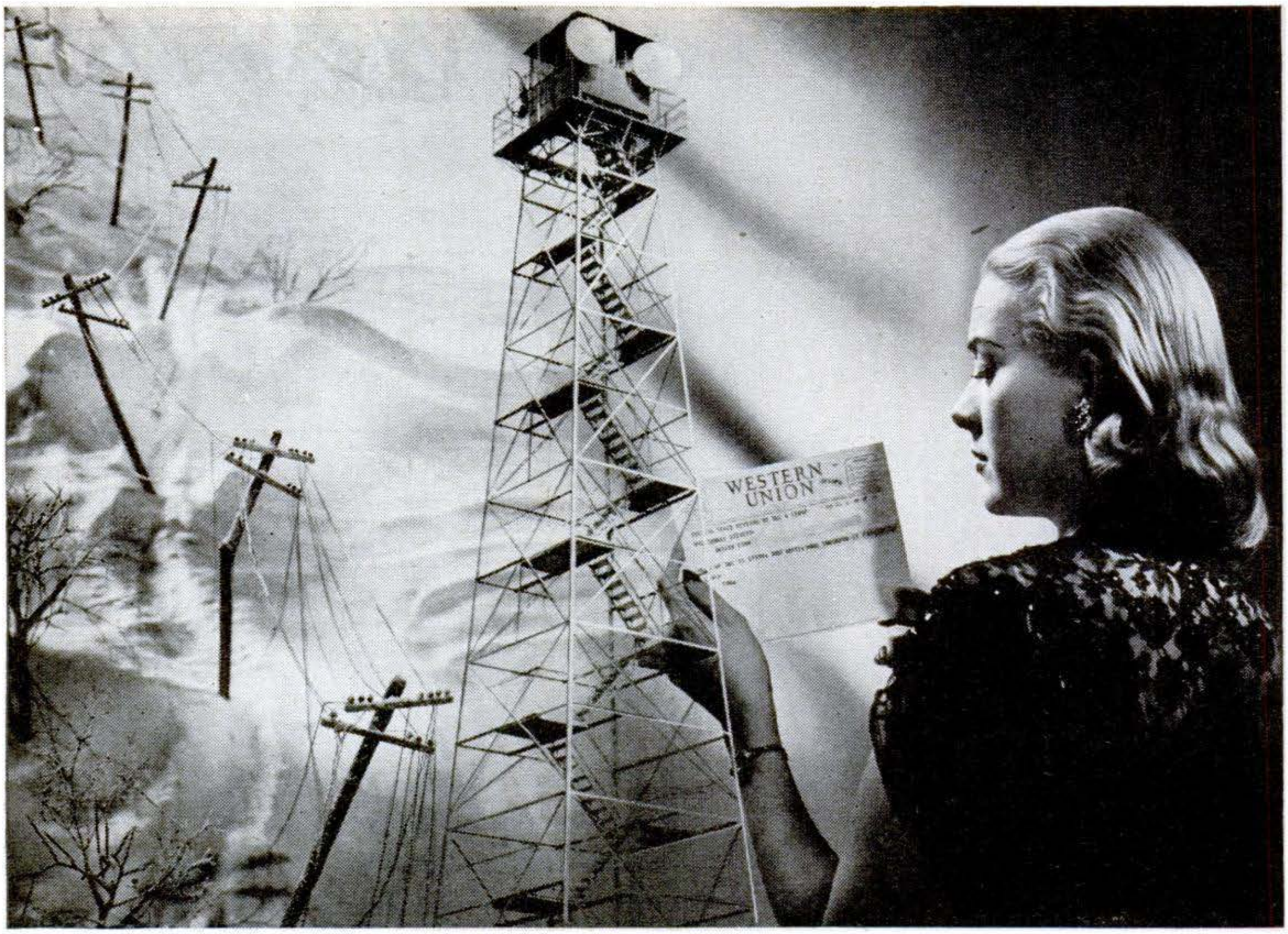


Radio relay towers, about 50 miles apart, will gradually replace thousands of miles of telegraph poles and wires.

Now, telegrams "leapfrog" storms through RCA Radio Relay

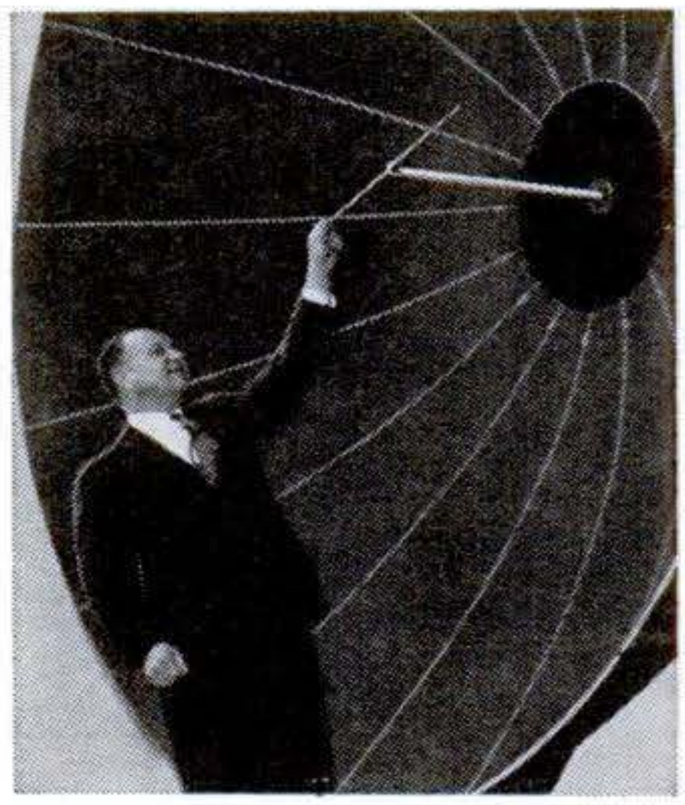
With the radio relay system, developed by RCA, Western Union will be able to send telegraph messages without poles and wires between principal cities.

"Wires down due to storm" will no longer disrupt communications. For this new system can transmit telegrams and radiophotos by invisible electric microwaves. These beams span distances up to fifty miles between towers and are completely unaffected by even the angriest storms. Moreover, the radio relay system is less costly to build and maintain.

This revolutionary stride in communications was made possible by research in RCA Laboratories—the same "make it better" research that goes into *all* RCA products.

And when you buy an RCA Victor radio or television set or Victrola* radio-phonograph, or even a radio tube replacement, you enjoy a unique pride of ownership. For you know, if it's an RCA it is one of the finest instruments of its kind that science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.... Listen to The RCA Victor Show, Sundays, 4:30 P.M., Eastern Time, over NBC Network.



Research in microwaves and electron tubes at RCA Laboratories led to the development by the RCA Victor Division of this automatic radio relay system. Here you see a close-up view of a microwave reflector. This system also holds great promise of linking television stations into networks.

RADIO CORPORATION of AMERICA

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POPULAR SCIENCE MONTHLY
VOICE OF SCIENCE

The Scientist Meets the People

[A statement by the Editor of Popular Science Monthly]

CLOISTERED for centuries, the scientist has suddenly found himself caught in a crowd and sharing, for once, the fears of the people. For the bomb which blew up the war also blew down the barrier between the scientist and the citizen.

Because of his nature and his work, the scientist has been a man apart. Understandably the priests of the absolute became as impersonal and implacable as the pure science they served. Those who have searched the stars and the mind for the fragments of total truth have shirked, in a sense, a responsibility for the social effects of their findings.

Now, some of the very scientists who helped unlock the frightening new knowledge are concerned about the huge and human implications of what they have done. They have formed the Federation of Atomic Scientists to awaken Americans to the full meaning of nuclear fission. In Washington, these honest and earnest men are schooling senators in the hard new truths of science which have suddenly been superimposed on politics.

Certainly the people were never more eager to learn about the thoughts and things which condition their lives and living. Certainly the scientist never had a greater opportunity and necessity to state his case. For the scientist, whether he likes it or not, is up to his neck in national politics, international affairs, military policy – and public welfare. This is his day and his time to talk.

But the language of the laboratory, however essential to precise expression in technical papers, holds little meaning for the millions. The scientist must learn the language of the people, must express himself in their terms, if he is to take his rightful place among the people; if the power he has loosed is to be administered for the benefit of the world.—PERRY GITHENS.

Photo by LI

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WHY U.S. NEEDS MORE SHIPS

By LEON SHLOSS

Ship Illustration by M. I. COHEN

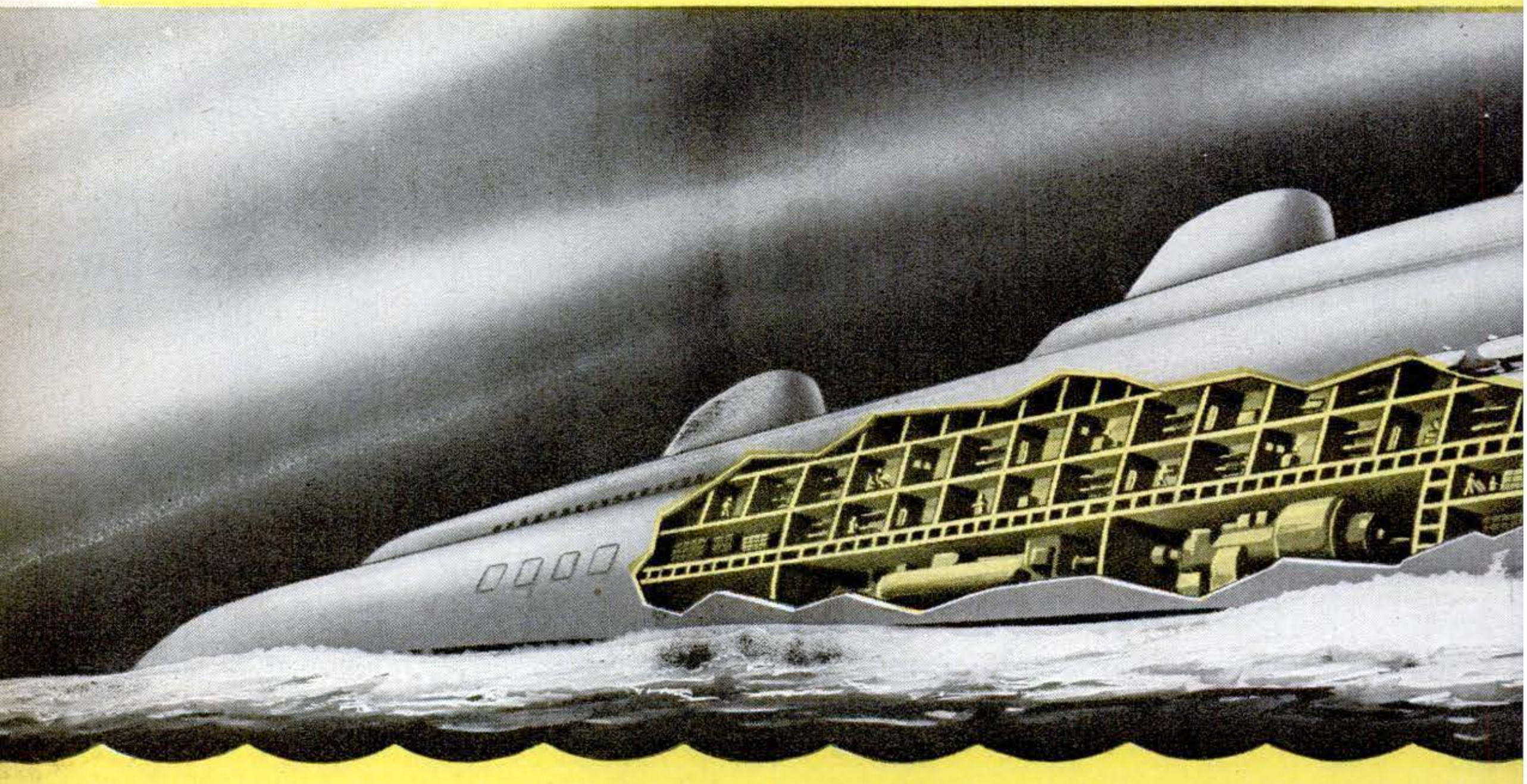
AMERICA'S postwar ocean liner will be a racy, streamlined, air-conditioned vessel 50 percent faster than her prewar cousin and packed with more comfort for passengers.

This is the superliner designed to spearhead the campaign to hold the United States merchant marine at its present world supremacy, to increase by 150 percent American prewar foreign trade carried in American bottoms, and to stave off competition by the airplane which maritime leaders admit is inevitable.

This ship is as symbolic of the future of America's merchant-marine future as the Essex-class aircraft carrier was of U. S. victory in the war. On the new liner's performance are pinned this country's hopes in the race for trade against the rest of a world which, through outright loss of prewar merchant tonnage, will build new, passenger-pleasing craft. If internal and international politics force America into the race with nothing but conversions from the nearly 45,000,000 tons of existing tonnage, government maritime leaders believe its present dominant position will be lost.

Three times in less than a century the United States has gained maritime ascendancy, twice lost it. In 1850, this country carried 70 percent of its ocean-going trade in its own vessels. By World War I, this figure had dropped to 10 percent. In that

Superliners for Main Ocean Highways



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war, foreign powers withdrew their vessels for war uses and America spent $3,000,000,000 building a merchant fleet. When the war ended, this fleet was scrapped, laid up, or sold for a song.

World War II found us with an 11,000,000-ton merchant fleet, 90 percent obsolete, and carrying only 20 percent of our foreign trade. Again, a new fleet had to be built.

Reckoning losses, and obsolescence, the merchant fleet now totals 45,000,000 deadweight tons, approximately 135,000,000 displacement tons. These ships, used according to plans laid by the Maritime Commission, will assure America's place in the cargo trade. These plans cover nearly 2,000 sailings a year over 35 strategic routes. These are the famous C-ships (C-2, C-3, C-4) developed by the Commission—with speeds up to 18 knots.

But these vessels will not compete in speed, appointments, and efficiency with the passenger liners that competitor nations are planning today. Germany and Japan are out of the picture. Italy's future is questionable. But Great Britain, Sweden, Norway, France, and Holland loom large in the maritime picture, with Britain the sternest competitor, while through the sky streaks the greatest threat of all—the airplane.

The immediate future will see a spirited contest between Britain and America, growing out of some very astute maneuvering on both sides.

The British did a rather sketchy job of converting merchant tonnage to war use. This can be seen in the *Queen Mary,* on which little more than replacing bunks with beds, and hanging stateroom doors, is necessary to get the *Queen* back in the luxury business. Meanwhile, this country virtually tore down and rebuilt its ships, installing many semipermanent features. Obviously, the British thus gained an advantage.

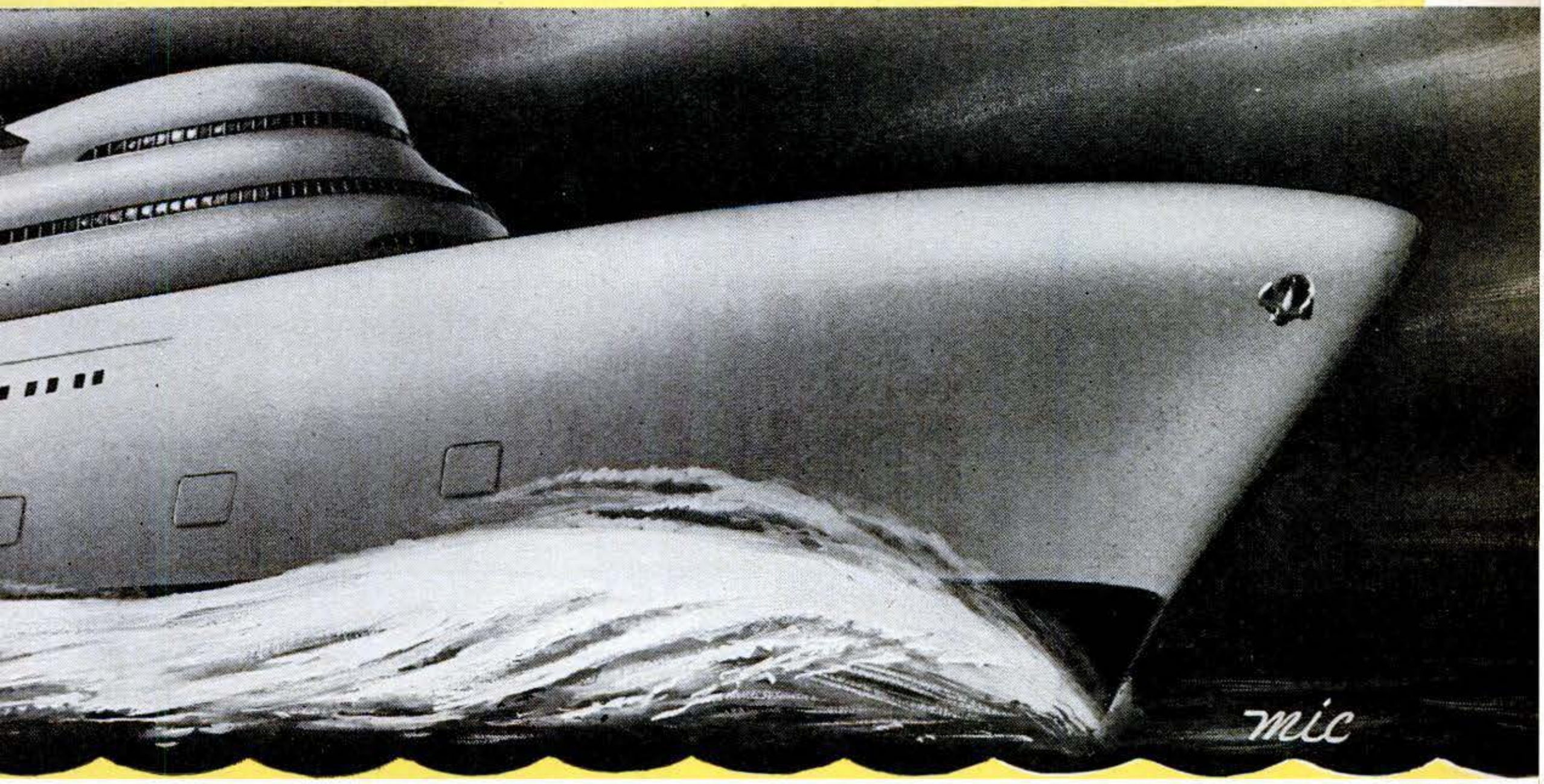
But the Maritime Commission wasn't idle. After the Liberty- and Victory-ship designs were perfected and war shipping was pretty much on an assembly-line basis, the Mari-

WAR SHIPPING WON'T HOLD WORLD TRADE

This country has just finished the biggest shipbuilding job in the world. More ships, aggregating more tonnage, now float under one flag than ever before. But war-built bottoms cannot compete in a peacetime economy with either the airplane or the subsidized liners of other maritime nations. With all our ships, the U. S. must build *still more ships* to protect its investment in world trade.

The Editors

Can Meet Air and Foreign Competition



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time Commission's technical people had time on their hands, which they used to good advantage by quietly perfecting plans for rapid and attractive reconversion of the 19 P2s in existence, and by drawing plans for the new superliners. The P2s are the biggest and fastest (22 knots) of the Commission designs, with the exception of the *America*. These P2s, soon ready for peacetime service, are America's best hopes for immediate use.

The airplane is not so easy to cope with. Vice-Admiral Emory S. Land, ex-chairman of the Maritime Commission, and James L.

TO ENGLAND: Five days in a 33,500-ton, 24-knot ship, accommodating 1,200.

Bates, Maritime Commission technical director, admit this. "Ultimately, the water transport of passengers will be so decreased," says Bates, "as to become rather a minor factor outside of the cruise for relaxation and recreation. However, if the passenger-ship development of the immediate future can be wisely conceived, the period of usefulness for such ships should extend through a couple of decades." And the Admiral adds that there's one advantage the ship still has—it is more comfortable, more restful, more leisurely.

Supporting the Land-Bates brief for the passenger liner is the fact that thousands of Americans with two- or three-week vacations and $400 or $500 to spend won't want to be set down in London or Paris or Rio, by plane, 24 to 48 hours after their vacations begin. In the first place, their money would run out in a few days. In the second place,

TO RIO: 7½ days in a 22,750-ton ship, doing 27 knots, carrying 250 to 500 passengers.

they wouldn't know anybody. On the other hand, shipboard life has an inherent informality that makes for easy acquaintanceship. These thousands *want* the long, lazy days and entertainment-filled nights at sea.

So, the new superliner will be the weapon of the government, the shipbuilders, and the operators in the coming struggle for business. It will be tailored to the requirements of each of five main routes:

North Atlantic: to England and France—Three 33,500-ton ships are projected. Each would accommodate 1,200 passengers and be capable of 24 knots (about 28 land miles an hour). Weekly sailings would be scheduled.

Atlantic: to Brazil and Argentina—Four 22,750-ton ships, each accommodating 250 to 500 passengers and capable of 27 knots, with weekly sailings and a 28-day turnaround. Fabled Rio will be just 7½ days, instead of 11, out of New York.

TO ITALY: Nine days in a 30,000-ton, 22-knot liner, with accommodations for 650.

Atlantic: to the Mediterranean—Three 30,000-ton ships, each accommodating 650 passengers and capable of 22 knots, with sailings about every 10 days.

Pacific: to Hawaii - Philippines - Japan - China—Two 37,500-ton ships, each accom-

By day, the superliner stateroom is a charming living room. Modern design and lighting are features.

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modating 1,000 passengers and capable of 29 knots, with sailings every two weeks and a 28-day turnaround. This run is viewed by maritime leaders as holding greatest trade promise for the United States, and they propose to make the Pacific an American travel lake.

Pacific: to Australia—Four 26,140-ton ships, each accommodating about 650 passengers and capable of 20 knots, with sailings probably twice monthly.

The Maritime Commission considered six or seven suggested types for each route before making its recommendations. Its decisions are based on surveys that show the

TO CHINA: 12 to 13 days in a 37,500-ton, 29-knot ship, carrying 1,000 persons.

prospective postwar passenger wants a good-looking, streamlined ship with appearance unmarred by the traditional forest of masts, booms, and funnels; that even when out for a relaxing, restful cruise, he doesn't want to be at sea too long, and that he wants real personal comfort, if not outright luxury.

To get rid of the jumbled superstructure it was necessary to devise a means of loading stores and cargo through ports in the side of the ship. This was done by development of a new side-port, cargo-loading gear (see front cover). The superliner's appearance was streamlined by application of aluminum shapes, made possible by wartime advances in aluminum manufacture and handling. These give the new ship a "turtleback," and this serves another purpose. Removal of the masts and booms leaves large additional areas of unencumbered deck space for recreation. Covering these areas with the "turtleback" provides shelter against the wind.

While the passenger's preference was an important yardstick in the Commission's deliberations, it did not overlook operating

TO AUSTRALIA: 20 to 22 days in a 26,140-ton, 20-knot vessel, carrying 650.

economy. Construction costs have been held to a point where any experienced operator, given legal construction and operating subsidies, can make an ample profit. In stateroom construction, for example, cost per room was set at $8,000 to $10,000, which allows for installation of attractive, utilitarian quarters.

From the mechanical standpoint, the Commission's studies indicated as most economically feasible the following features:

Total horsepower per shaft, 50,000.

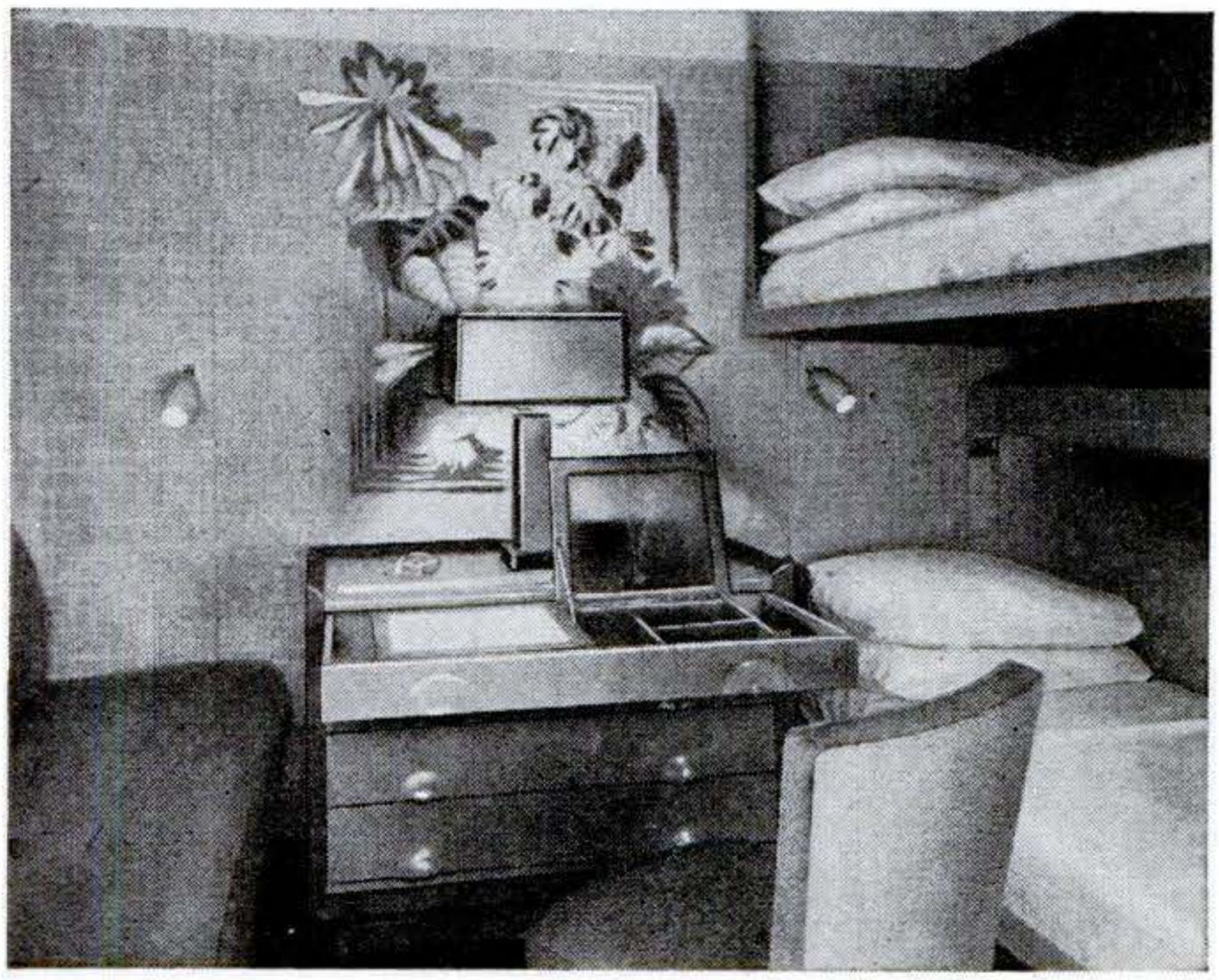
Machinery located in two independent and well-separated compartments.

Boiler efficiency 88 percent or higher.

Motor-driven auxiliaries.

In tailoring the new ships to the requirements of the five vital routes chosen for prime American participation, weather and sea conditions were intently studied. On

By night, stateroom beds are pulled out of the wall and a desk is opened to provide a dressing table.



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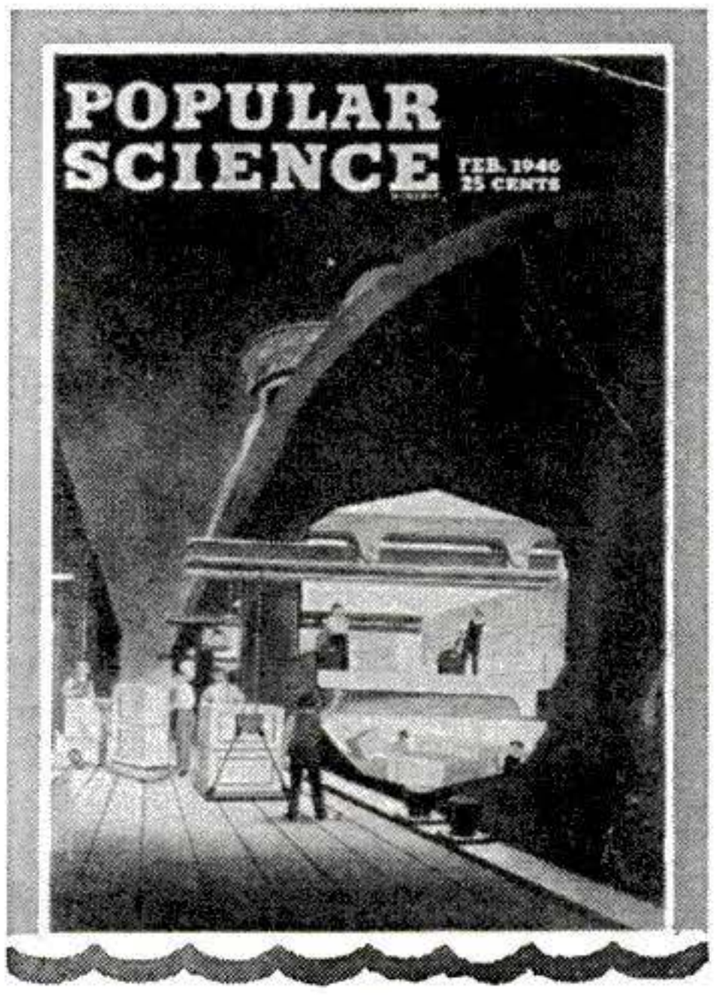
semitropical runs, great length and small beam are desirable in order that as many outside staterooms as possible can be installed. In the Pacific, flatter waves and fairer weather are found than in the North Atlantic, hence less displacement is necessary.

Of the five types, those for the North Atlantic, South American, and Central Pacific are entirely new, and of Maritime Commission conception. For the Mediterranean run, the Commission found that a design developed by American Export Lines fitted the requirements ideally, so it was adopted. For the Australian run, existing ships of the Mariposa type have met all needs, so it was decided to use them.

Detailed designing of the interiors of the superliners has been left largely to the operators to fan the competitive spark needed to assure the traveling public the finest in service and accommodations. The operators are hard at work now. Compact, but comfortable staterooms full of pleasing gadgets will be the rule. Beds will fold into the wall, leaving no trace of their existence, so that staterooms by day will be comfortable living rooms. The passenger will be able to retire, without waiting for an often-busy steward, simply by pulling down his bed and getting in. The writing desk will open, swinging a mirror upward, to provide a dressing table. Some plans call for regular windows in staterooms, rather than the traditional portholes. Copper-backed, flesh-tinted mirrors will create the illusion of depth in staterooms, at the same time maintaining warmth.

Noncombustible plastics, which are alcohol- and cigaretteproof, will be used extensively in tables, dressers, picture frames, and other ornamentation. Balustrades and railings on open stairways and around swimming pools will be made of clear plastic whose power to absorb and refract light will give fascinating luminous effects. The heat test required by fireproofing regulations, however, will limit the use of some plastic ornamentation.

The public spaces—dining rooms, card rooms, taprooms, deck cafes, wide promenades, swimming pools, and spacious recreation decks for outdoor games and sun bathing—will incorporate all the improvements gleaned from war's technological advances. Air conditioning will be carried to every room, with temperatures and relative humidity automatically controlled. The heavy wood paneling and decorative trim of the past—extreme fire hazards—will be replaced by fireproof insulation combined with fireproof veneers. Instead of being disguised by wood veneers or other coverings, bulkheads may be painted in pastel shades. Warm, sepia-toned photographic murals are planned for wall spaces.



Side loading for ocean liners will mean faster turnarounds.

The color as well as the amount of interior lighting may be controlled by turning a dial. A plastic material will screen ceiling lights. It is produced in a thin, transparent sheet, lined with opaque or colored louvres which prevent the light from shining in the eyes. An open-air swimming pool with iridescent lights glowing beneath the water will be a nighttime attraction.

Research and experience have made it possible to build completely fireproof ships. Contributing importantly is the new Fiberglas wool, made of minute glass filaments bonded together, which provides high-grade fire resistance. For decorative purposes, fabrics for draperies and chair coverings have been perfected which are entirely fireproof.

If the postwar ocean passenger is worried about home or office, he can use the ship-to-shore dial phone on the table beside him. He can relax in complete assurance that his radar-guided ship isn't going to hit an iceberg.

Ever noted for forthrightness, Admiral Land, before resigning as Maritime chairman, summed up American ocean-trade aims succinctly.

"We don't want to hog the seas," he said. "We want only our fair share. And our aims are very modest."

He viewed international competition as healthy, if it didn't degenerate into subsidized throat-slitting.

"There's one fallacy in that whole line of argument," the Maritime Commission's ex-chief maintains. "It assumes that there is only so much trade in the world, and it will have to be sliced up like a melon. Well, I don't believe that. I think we've got to work for lower tariffs and freer trade all over the world, so that the total volume of trade will increase.

"If that occurs, the whole world will be more prosperous, and there'll be a real need for all the fast, modern shipping afloat in the world, including ours."

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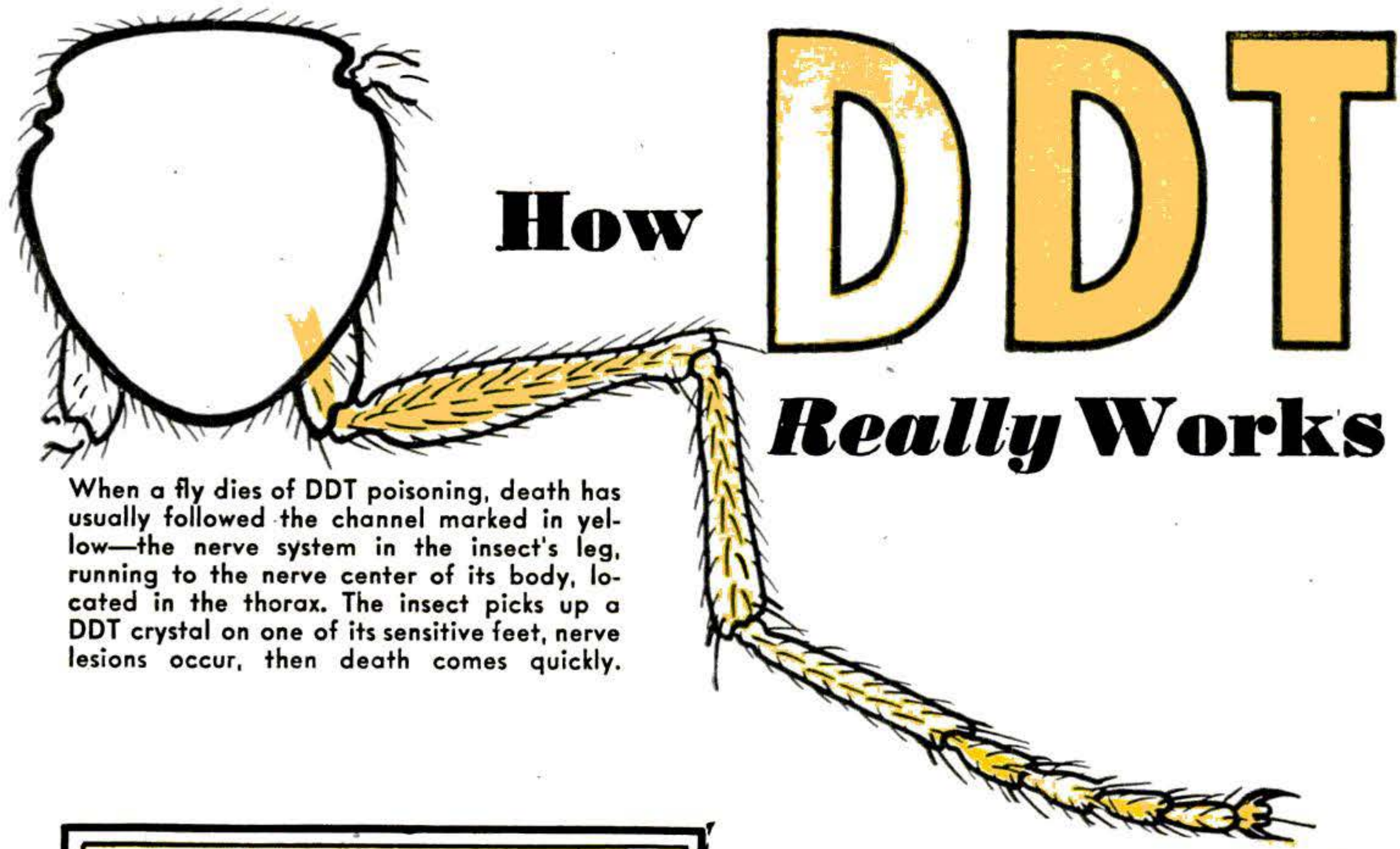
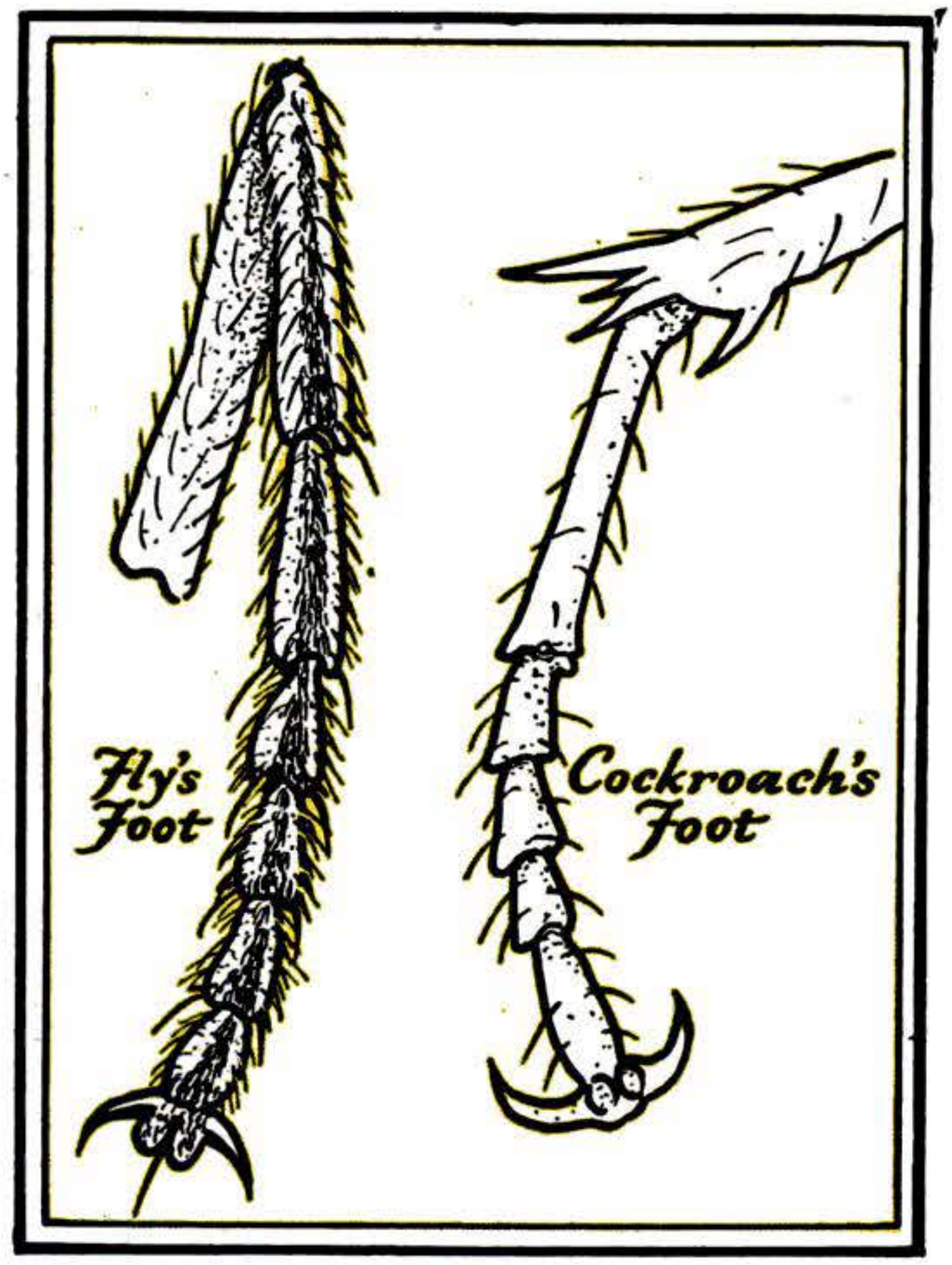


How DDT Really Works

When a fly dies of DDT poisoning, death has usually followed the channel marked in yellow—the nerve system in the insect's leg, running to the nerve center of its body, located in the thorax. The insect picks up a DDT crystal on one of its sensitive feet, nerve lesions occur, then death comes quickly.



This drawing makes it clear why DDT kills flies effectively but fails to rub out cockroaches. A fly's foot is covered with sensory hairs, longer and finer than other hairs. If a crystal of DDT lodges on any one of the many hairs that form the sole, the insect's swift demise is almost certain. The foot of a cockroach, on the other hand, is smooth and highly polished. Since it does not pick up the microscopic crystals of poison, the cockroach can walk over them with practically no danger.

Wonder insecticide has limits, and you had better know them.

By DR. C. H. CURRAN

Associate Curator, Department of Insects and Spiders, American Museum of Natural History

DDT, the wonder insecticide, may be a blessing—but can be a curse. Properly used, it can eliminate many insect-borne diseases. Scattered broadcast over field and forest it may harm our fish and wild life, kill the helpful insects essential to agriculture, and even damage the crops themselves.

What is worse, recent research shows that overuse of DDT may directly harm man. We now know that DDT goes into the butter and cream of animals eating fodder sprayed with the poison—and if too much is used, the concentration is dangerously high for humans.

These dangers result from two special characteristics of DDT. It is selective in the way it kills. And it keeps on killing for months.

The first effect of DDT on a housefly is to make him very nervous—not because he knows what is ahead for him, but because DDT kills in a different way. It attacks the nervous system, very much as strychnine affects a man.

When DDT dissolved in kerosene is sprayed on a wall it evaporates, leaving microscopic white crystals. The surface is

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so covered that an insect cannot walk over it without treading on a crystal. A single contact is lethal to such susceptible insects as flies, mosquitoes, and bedbugs.

The foot of a fly is particularly vulnerable because of its extremely efficient sense organs. The skeleton (the outside of a fly) is thin at points near the ends of the joints. In addition, there are sensory hairs, longer and finer than other hairs. In fact, the whole bottom of a fly's foot is so sensitive that death is almost certain when a DDT crystal lodges in any of the many hairs that form the sole.

The nerves react quickly. The fly rubs its legs together or rubs them over the wings, crawls about rapidly, and picks up more crystals. Inside the affected foot, the nerve swells slightly. Nerve lesions then are formed in various parts of the body and eventually in the central nerve mass of the thorax—the part of the fly between its head and its stomach. Death then follows quickly.

The poison is also effective when a droplet hits the fly's breathing pores or other sensory areas. The insect may die, too, from eating food containing DDT. Unless the poison passes through the digestive system very quickly, post-mortem examination will reveal the same nerve lesions as though the fly had walked on DDT.

Few insects have as sensitive and vulnerable feet as the housefly. Beetles are protected by an armored external skeleton, and DDT touching the wing covers or other impervious parts has no effect. The cockroach has a highly polished outer covering to which foreign matter does not adhere. The caterpillars of moths and butterflies, and the larvae of most insects, have a very thin skeleton and are much more susceptible. Some insects with a thin skeleton, however, such as the silverfish and firebrats, are protected by a silky fleece that repels even an oily spray. *These differences in insects explain variations in the effectiveness of DDT.*

Not even all flies are potential victims. The tough feet of many large flies protect them. It takes a heavy dose to kill the bluebottles and green-bottles. The services, for example, found DDT rather ineffective in controlling *Chrysomyia*, the green-bottle fly that carries dysentery and jaundice. Despite reports that all of the harmful insects were wiped out on some Pacific islands, the hard-to-kill insects were not destroyed on any island.

The general rule for determining the effectiveness of DDT is: The larger the insect or the harder its outer skeleton, the more resistant; the smaller or more delicate, the more susceptible.

Many of the most vulnerable insects are valuable to man—in fact, it is doubtful if mankind could survive without them. Some flies, for example, furnish food for fish; some are parasites of insect pests or feed upon them, and others pollinate flowers. These friendly types are the most easily killed by DDT. The same is true of another great order of insects, the *Hymenoptera,* which includes bees, wasps, and ants. Some of them, such as the sawflies and certain ants, are pests, but the vast beneficial majority also dies from DDT.

Experiments in Ontario by the Dept. of Lands and Forests show what happens when DDT is used out of doors. Damage to trees was limited to burning of leaf edges. Carnivorous water beetles and some other aquatic insects were not greatly affected but died because the insects on which they fed were destroyed. Other aquatic insects were killed directly. Crayfish, which feed on insects and themselves serve as fish food, were very susceptible. Minnows were killed by contact and trout died from eating poisoned insects. Six kinds of frogs and two kinds of snakes were killed, either by contact or by eating poisoned insects. *Any DDT field spray is likely to destroy more than half of these amphibians.*

The susceptibility of fish and amphibians makes spreading DDT on or near water dangerous. Experiments have shown that one pound of DDT per acre will kill the larvae of *Anopheles* (malarial) mosquitoes, which feed on the surface. The dose must be considerably increased, however, to kill other larvae. Then, other kinds of animal life feel the impact. As little as one part of DDT to 10,000,000 parts of water will destroy most fish. Unfortunately, once DDT has been deposited, it is out of control, and even a light spray for *Anopheles* may be concentrated in one end of a pond by wind and waves and destroy all the cold-blooded animals in the area. If a dust is used, this may be blown from foliage and concentrated similarly. At Bear Mountain Park in New York we found that plain kerosene was as deadly to mosquito wrigglers as a DDT solution—and did not kill the amphibians.

A further objection to the wide use of DDT in larvae control is the danger of contaminating the water supply. Fear of this led us to abandon plans to use DDT extensively outdoors at Bear Mountain Park. Heavy rains might wash the DDT into reservoirs. We were not fully aware of the deadly effects of the chemical then, but we received word from Okinawa later that several natives had died from eating DDT, and post-mortem examination revealed nerve lesions similar to those produced by strychnine.

From the evidence at hand, it is clear that

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widespread use of DDT out of doors may have far-reaching effects. The impact upon the fish population, for example, goes beyond the losses from direct poisoning and feeding upon poisoned insects. The millions of midges that live near water are fish food and also feed aquatic insects such as stone flies and diving beetles, which are another part of the fish diet. The midges are particularly vulnerable to DDT. When they die, the aquatic insects starve. And when both midges and aquatic bugs disappear, fish perish.

The same chain reaction hits birds. They apparently are not killed by eating insects poisoned by dosages of less than one pound of DDT per acre, although larger dosages are likely to destroy them. But destruction of the bird's food supply—the caterpillars, flies, and larvae that are the first victims of DDT—by weekly dustings or sprayings would raise havoc with our song and game birds. When man brashly tampers with the balance of nature, more harm than good may be done.

Bee-keepers, already alarmed by the destruction of their charges through ordinary orchard sprays, fear DDT may be the final blow. Without insects, there will be no pollination; without pollination, there will be no seed; without seed, there will be no plants.

DDT's effects on insects may not be noticed for several days or even weeks, so the user may repeat the treatment with a solution or dust two or three times as strong. Most authorities agree that one pound per

DDT has been sprayed experimentally to control mosquito larvae, but it has killed too many helpful things in water.

Pure DDT powder looks like flour, has only a faint odor, can easily be mistaken for cooking powders.

Use of pure DDT is not recommended. It is better to dissolve it in oil or kerosene and use it as spray.

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acre, or 20 gallons, is the largest amount that can be safely used. This is a very small dosage and the man accustomed to using four or five times as much insecticide will be strongly tempted to overdo it. The DDT might then kill people, because recent experiments have shown that it tends to concentrate in the milk of animals fed on DDT-treated food.

In the face of these dangers, some proponents of DDT are strangely nonchalant. The statement of the extension service of a New England state that "there is no reason to believe that DDT will upset the biological complex any more than many other common insecticides when used in the same manner" overlooks the staying power of DDT. Whereas other insecticides are effective only right after application, DDT keeps on killing bugs for weeks or even months after it is applied.

DDT belongs in the home, in my opinion. Within four walls, it can be controlled. Used extensively, DDT may well eliminate malaria and dengue from the United States. Both of these diseases are transmitted by mosquitoes, which become infected by biting diseased persons. Fortunately, both ailments take a week to develop inside the mosquito and during this time the insect cannot transmit the disease. If we can kill the pest in that week, we can halt the infection. DDT will do this. Sprayed on the dark portions of rooms, under desks and chairs, and, better still, on all the walls, DDT picks off the adult mosquito, frequently before it has a chance to bite. Since mosquitoes usually remain in a house for several days, they can be destroyed there and then.

At Bear Mountain we controlled houseflies in buildings merely by saturating lamp pulls and spraying hanging light fixtures. Additional protection can be given by spraying walls and ceilings, particularly where flies light. A single treatment is usually enough around the house, but two or three applications a season may be required in stables or dairy barns.

Application of DDT to walls and surfaces is much preferred to general spraying. The aerosol bomb has the additional disadvantage of leaving fine particles of DDT floating around a room for several hours, during which they may be inhaled. If the bombs are used, the rooms should be aired for a considerable time before being occupied. For application to walls, DDT dissolved in kerosene is much more effective than water solutions.

DDT's value against carpet beetles is extremely doubtful at present. Silverfish and adult clothes moths are killed only when the application is fresh. *There is no evidence that it kills moth larvae except by direct contact.* In my own tests, both silverfish and cockroaches greatly increased in numbers even when I used a 10 percent solution or dust. Nor have I found DDT effective against dog ticks.

Housewives who believe reports that DDT kills quickly will be disappointed. Killing mosquitoes may take more than 10 hours, and houseflies more than 24 hours. Bedbugs usually expire in from one to five hours. Within its limitations, however, DDT is one of the most amazing insecticides known.

Don't Do This

DON'T leave DDT where children or animals can get at it. Label it POISON and keep it locked up. When eaten, it can kill.

DON'T use DDT outdoors to control forest or farm pests or remove bothersome insects. It may injure wild life, destroy beneficial insects, damage plants, and pollute reservoirs.

DON'T spray DDT in the air like an ordinary insecticide. It is ineffective and expensive; either pyrethrum or rotenone is better. The aerosol bomb is undesirable, both as a spray and because particles of the poison linger in the air for several hours. Instead, spray or paint DDT on walls and fixtures.

DON'T use DDT powder. A kerosene or oil solution is both cleaner and more effective.

DON'T worry about the mixture being too weak. As little as one-fourth of one percent DDT in solution can do the job, if properly used.

DON'T expect results when used against cockroaches, silverfish, carpet beetles, or clothes moths. DDT works best on flies, bedbugs, mosquitoes, fleas, and lice.

DON'T use DDT for termite control.

DON'T use on animals, such as cats, who clean themselves by licking.

DON'T use DDT around persons allergic to it. They may develop skin eruptions or puffy lips, nose, and eyes for several weeks after spraying.

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BALLAST TAKEN ON ALOFT

Without slowing down, a Navy blimp over Lake Erie takes on water ballast through a hose attached to a "fish." Connected by cable to the airship, the "fish" contains a motor and pump. Tanks are filled to the point where the blimp's lift offsets its weight.

THE U. S. Navy is experimenting with a means of solving one of the vexing problems of long-range dirigible flight. If a Navy-designed, water-pickup device works, airship men will not have to worry about balancing off the weight of their aircraft against the lift of the gas cells. Such a device would enable transoceanic airships to pump ballast from the ocean while traveling at top speed.

As fuel is used, an airship becomes lighter. The crew either has to valve away precious helium, the lifting gas, or find a way to keep the weight constant. It is another version of the ballast problem in the surface vessel, except that in a lighter-than-air ship ballast is more critical.

German dirigible men sometimes valved away inflammable hydrogen to offset weight with lift. Hydrogen was cheap. But helium, the noninflammable gas used in American dirigibles and blimps, is too expensive to valve out. One means of maintaining balance has been to recapture the moisture from exhaust gases. In addition to that system, troughs on the airship's skin have also been used to collect rain water. The condensing system for the exhaust gases was, of course, heavy and served to reduce the airship's pay load.

Cruising over Lake Erie, a Navy blimp has experimented with picking up water ballast from the lake surface. The airship tows along a hose line attached to a "fish" containing a pump. Ballast tanks are filled to the point where the airship's lift exactly offsets its weight. Taking water "on the fly" is similar to a locomotive's scooping up water at high speed from a trough between the tracks.

The tests have been conducted at Akron, Ohio, in co-operation with the Coast Guard and the Goodyear company, builder of the K-10, the blimp used in the experiments.

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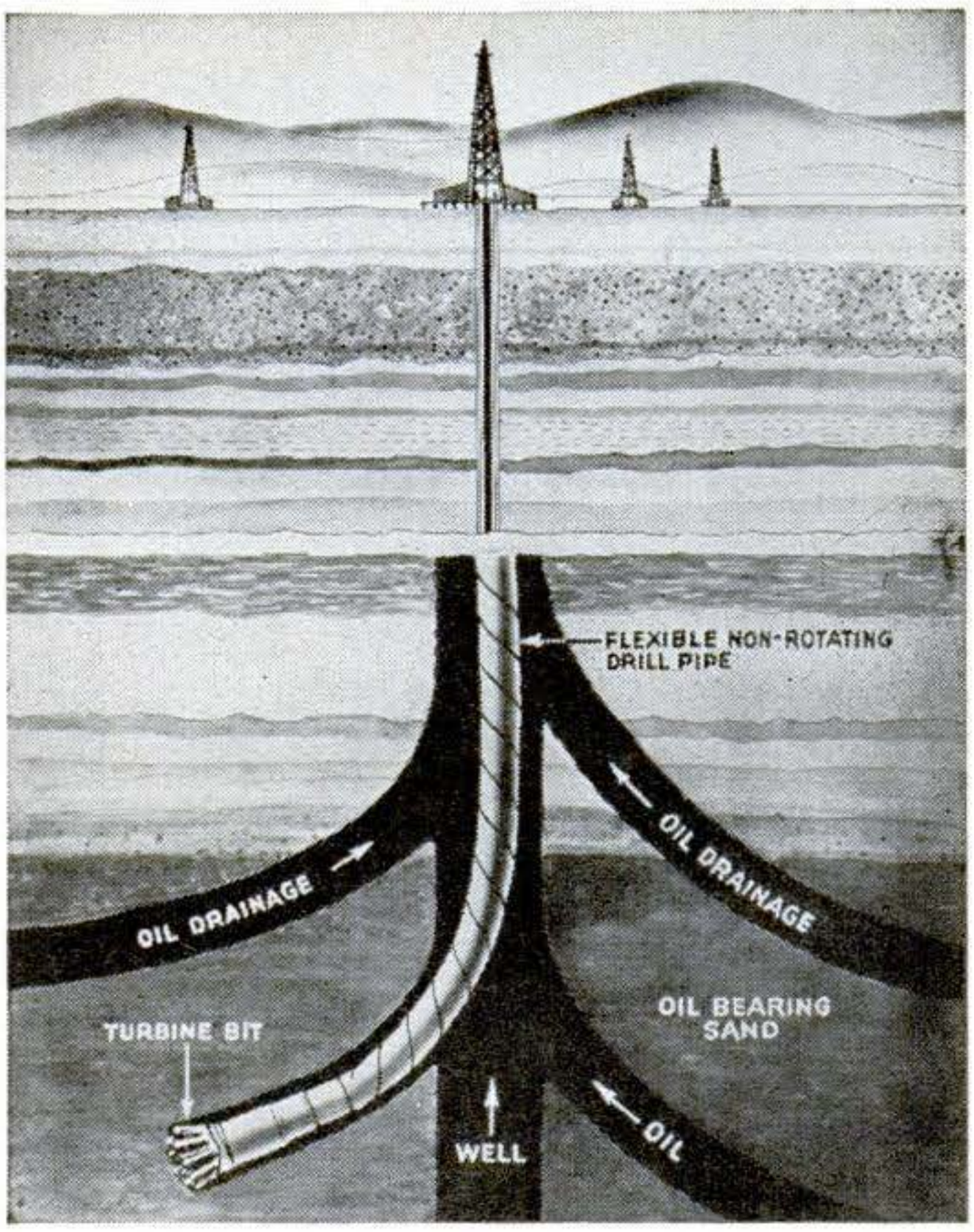
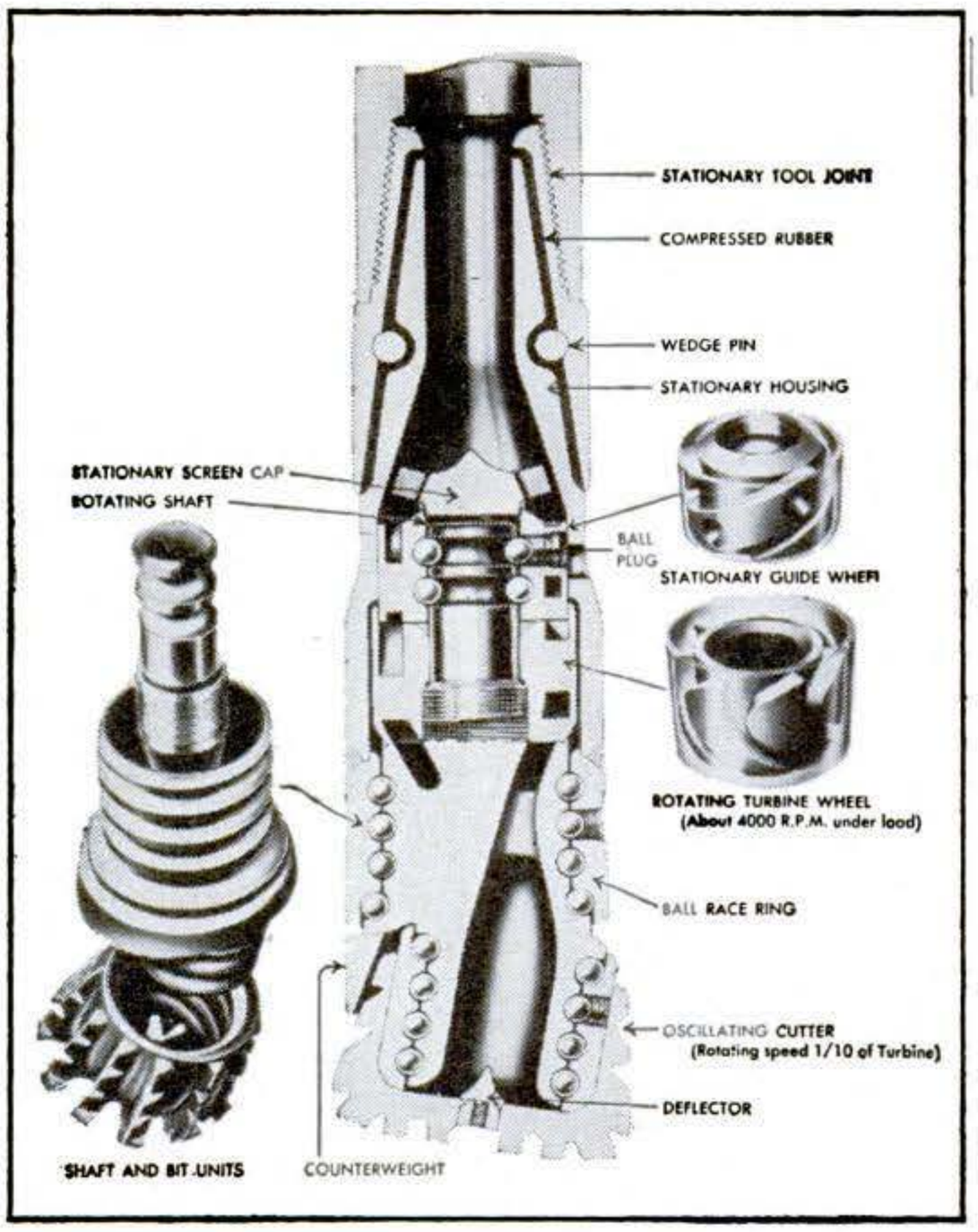


The flexible drill curves away from the main shaft (left), as tree roots reach out for nourishment, to drain oil-bearing sands around it.

Business end of the flexible drill (below) is operated by mud-water under pressure. It is forced down heavy rubber liner inside pipe, returns outside.



FLEXIBLE DRILL EXPLORES UNTAPPED OIL SANDS

WITH a turbine bit actuated by mud-water and a pipe that can be curved and straightened at the will of the operator, John A. Zublin of Los Angeles has been able to reach sands in oil strata heretofore untapped in drilling for petroleum. In tests of his apparatus, an oil well's production has been increased as much as 20 times.

In standard well drilling a hollow drill pipe is rotated and a bit at the end does the cutting. The well is sunk straight down. Production can be increased somewhat by shooting a "gun perforator" into the oil sands immediately adjacent to the shaft.

Zublin, seeking a way to reach sands as much as 100 feet away from the bottom of a well, uses a flexible drill pipe. It does not rotate. To its end is attached a dragon-tooth bit. Pressure of mud-water flowing through a rubber interlining of the pipe whirls a turbine immediately behind the bit, and this turbine, in turn, whirls the bit.

The flexible pipe assumes a curved position when tension is applied to it. The bit is set against its shank at a 10-degree angle to facilitate angular cutting. To keep the flexible pipe straight as it is lowered into a well, a steel mandrel is inserted. This is withdrawn when the flexible pipe has reached the drilling level.

In tests, three horizontal holes extending 51, 72, and 100 feet were drilled from the bottom of one well.

"Explosion-Proof" Motor Snuffs Its Own Fires

THE possibility that fuel vapors, leaking into airplane interiors, might be exploded by a spark from an electric motor led the AAF to institute a test for sparkless motors.

The tests were conducted by putting motors into a cylindrical tank and piping high-octane vapors both into the motors and around them. Set off by a spark, the vapors inside the motors exploded but without transmitting heat to the vapors surrounding them.

The secret of the explosion-proof motors is casings that snuff out flames before they can get through to surrounding gasoline fumes or even cause damage to the motor itself. Openings in the shell of the motor are very narrow. "Paths" leading from any point where gases might burn in the motor are so long that, in traveling them, the gases are cooled below the ignition point by the time they reach the outside.

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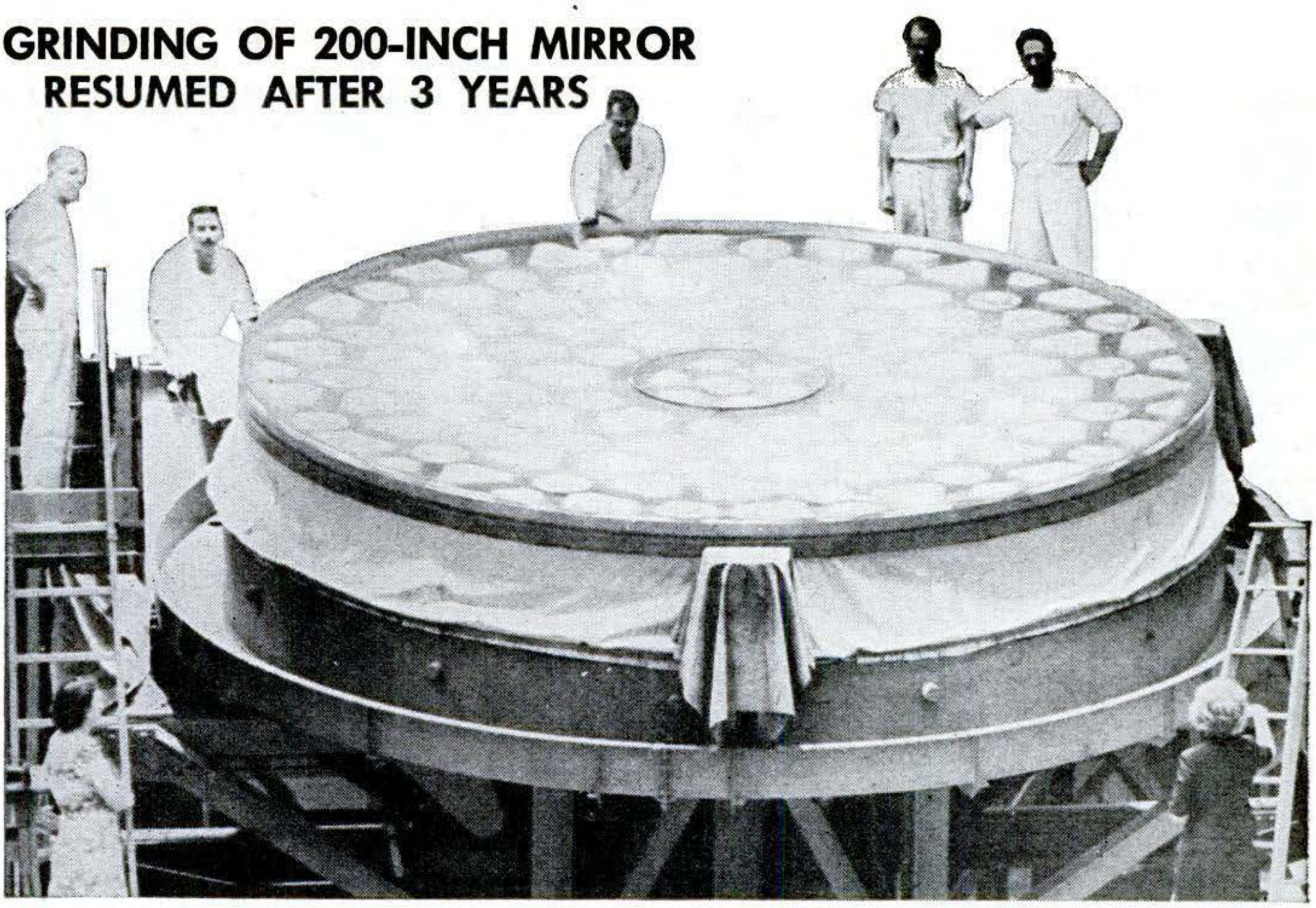
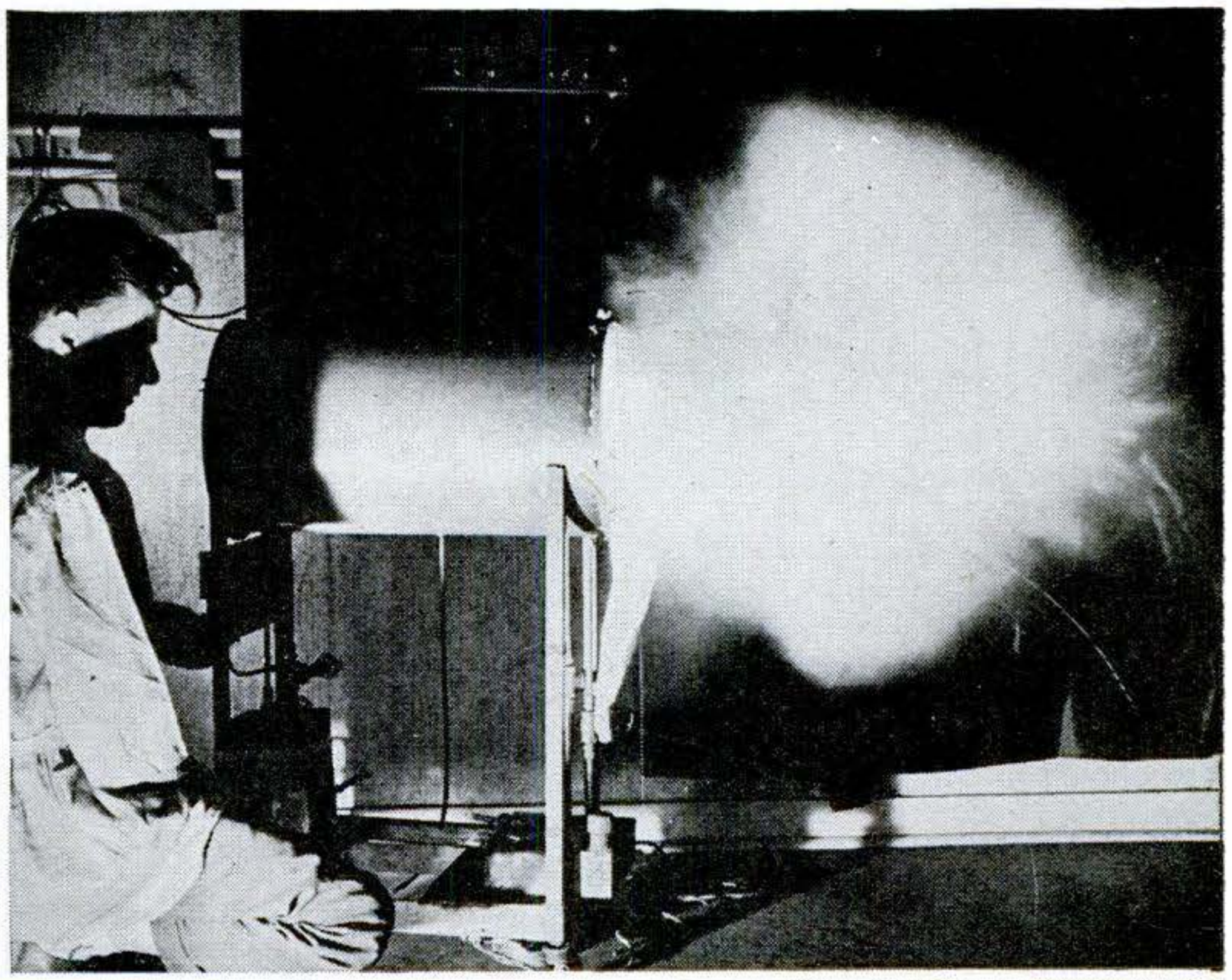
GRINDING OF 200-INCH MIRROR RESUMED AFTER 3 YEARS



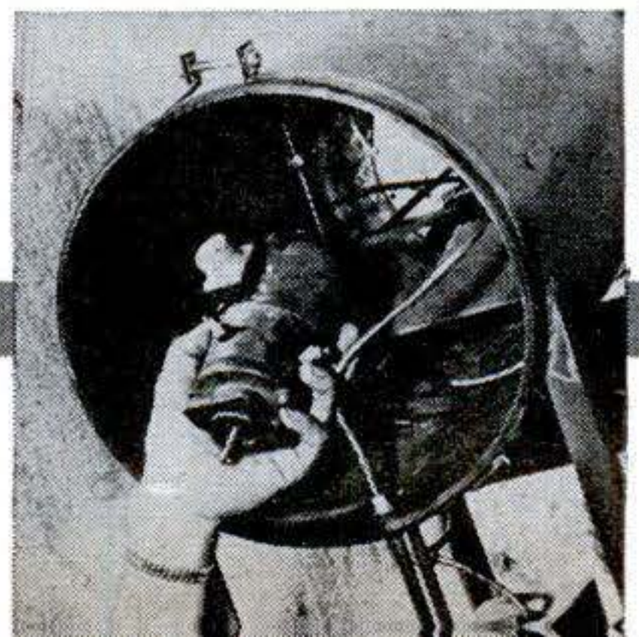
GRINDING of the world's largest mirror, due to be ready in 18 months for the big telescope on Mt. Palomar, California (P.S.M., Jan. '46, p. 130), has begun again after a wartime layoff of three years.

The 200-inch disk, after a delicate and difficult cross-country journey, arrived in 1936 to be ground and polished in a machine 30 feet high (P.S.M., Dec. '35, p. 29), built for California Institute of Technology.

Deliberately exploding 100-octane gasoline vapors (right) at the mouth of the cylinder in which he has been testing "sparkless" motors, this laboratory assistant proves he really has been working with a dangerous mixture.



An explosion-resistant motor is fitted into the special test cylinder that then is sealed and filled with gasoline fumes to determine if the motor can be used safely in planes.



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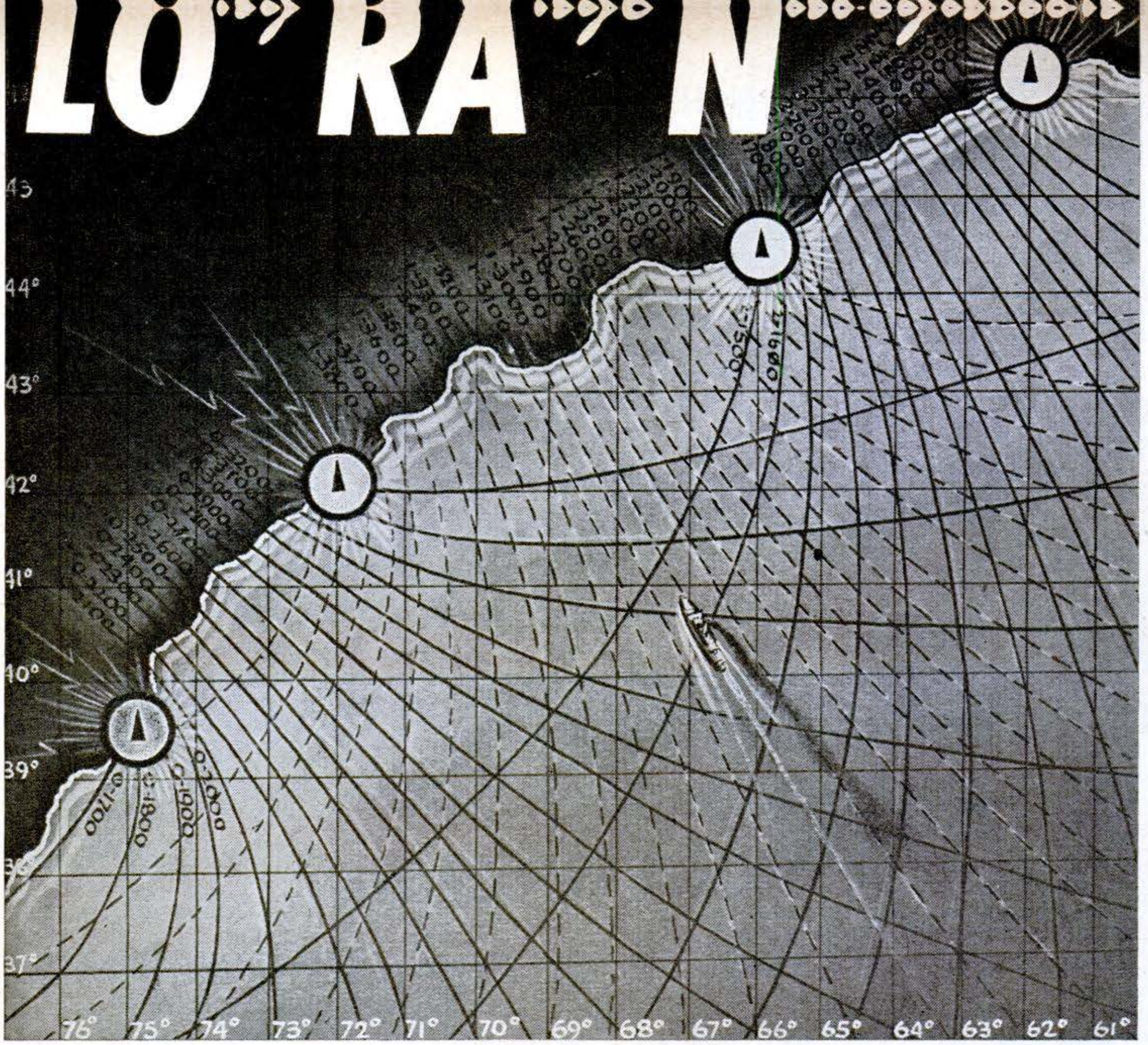
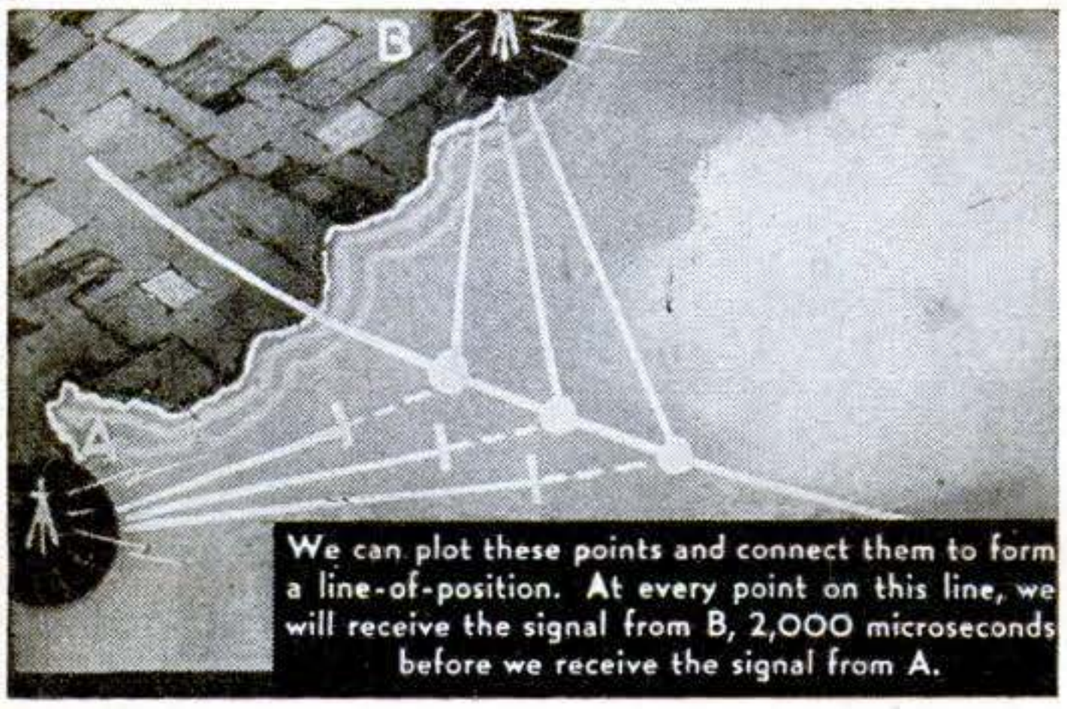
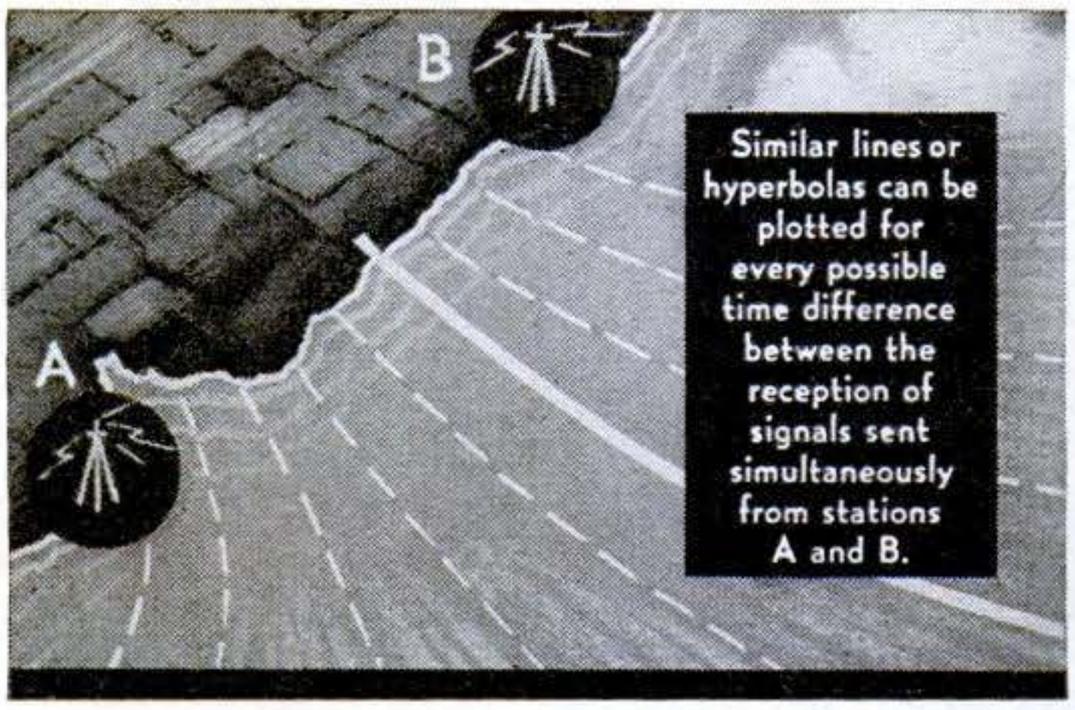
LORAN



PLOTTING CHARTS are keyed to readings on the Loran oscilloscope, which records in needles of light the signals it receives from sending stations. These stations are electronic beacons, about 70 in all, covering most of the North Atlantic, much of the Pacific, and parts of the Indian Ocean, India, Burma, and China. They are usually in "chains" of eight. Readings of the oscilloscope—or the time lapses in receipt of signals from the sending stations—must be taken from two pairs of master-slave stations (drawings at left and below) before an airplane's or ship's position can be plotted. Position is indicated by intersecting lines on plotting chart.





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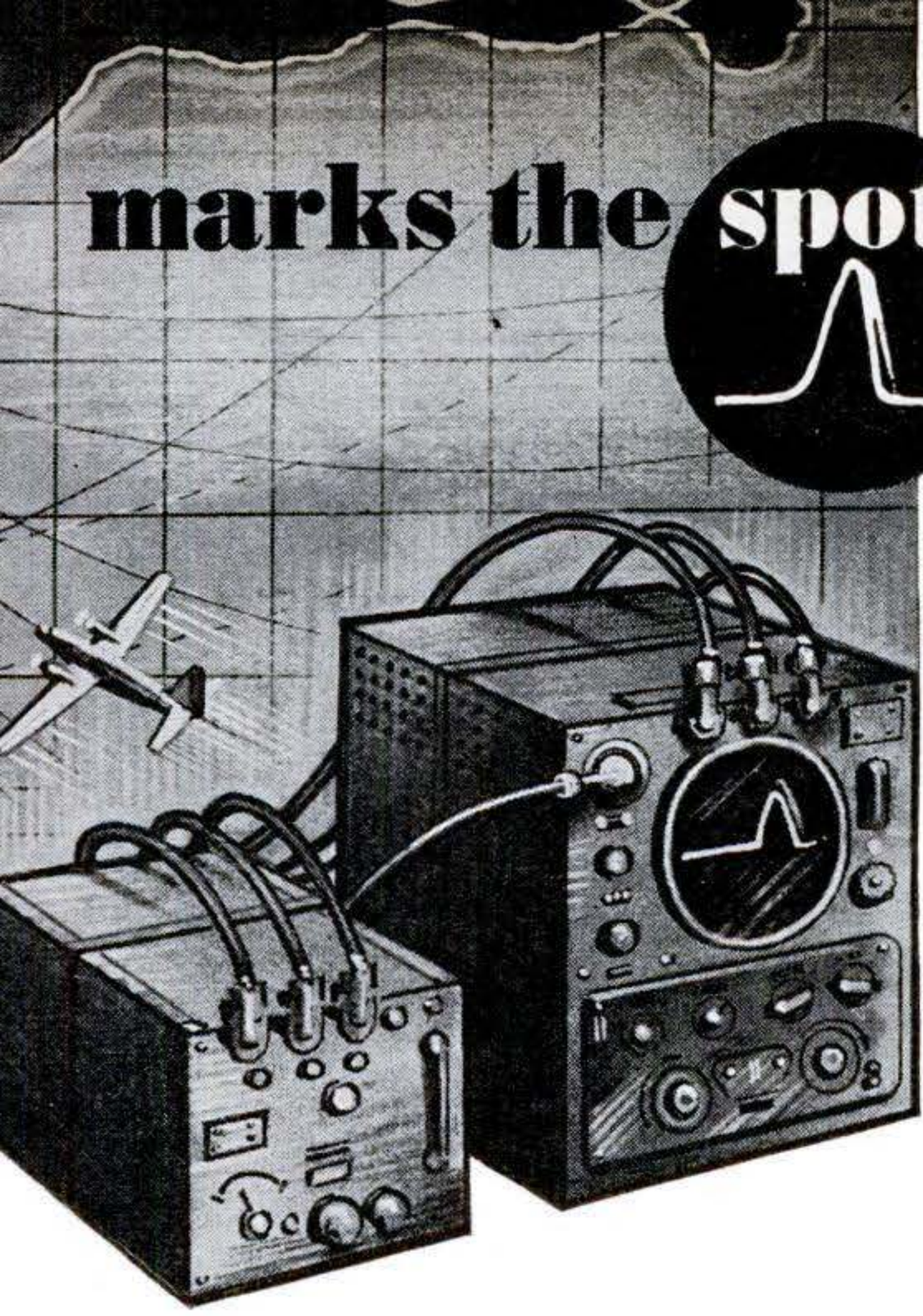
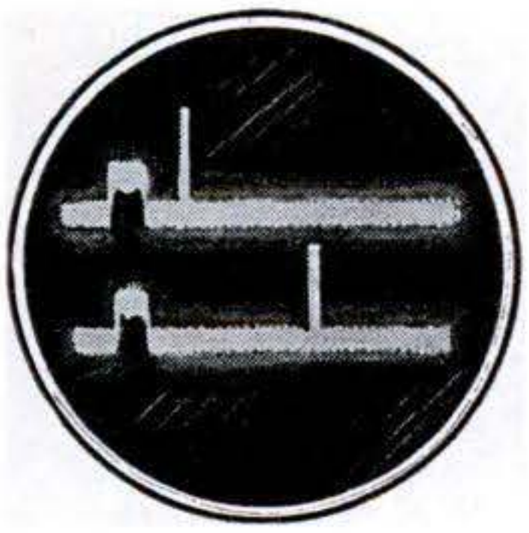
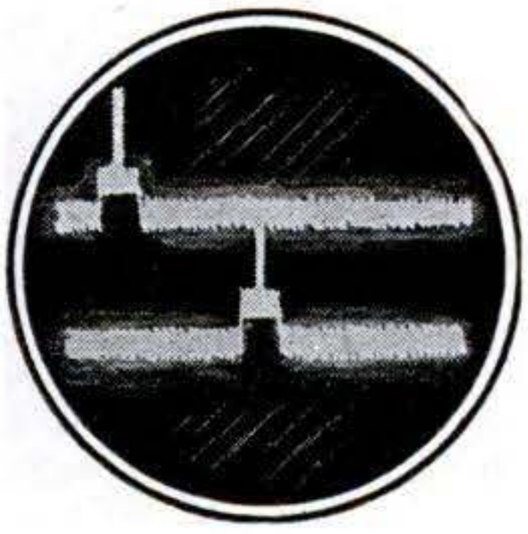
marks the spot where you are!



POWER UNIT (left) and oscilloscope comprise the "brains" of Loran. U. S. radio manufacturers, given "breadboard" model to work on, in only five months engineered production models to help fight battle of North Atlantic against U-boats.

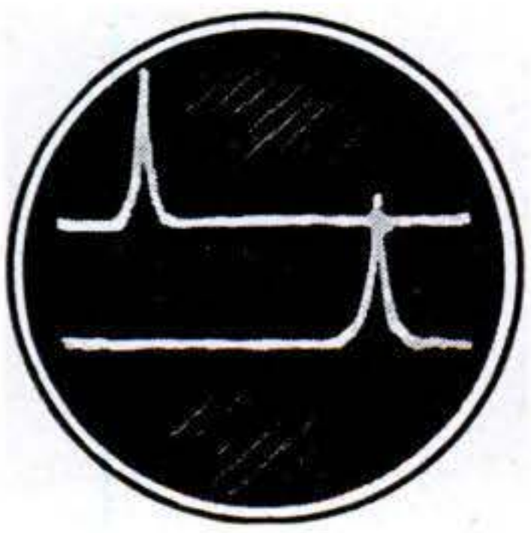


1. Loran operator, by tuning in two stations, stops "pips" of light moving across 'scope.

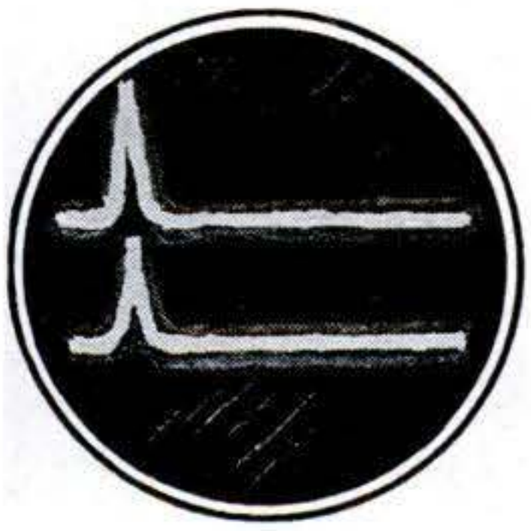


2. "Pedestals," the measuring points on "traces" (horizontal lines), next are lined up with pips.

3. Control on the oscilloscope magnifies the image to such an extent that only tops of the pedestals and pips show.



4. Pips are aligned, permitting the operator to read the time-lag difference between the "master" and "slave" stations.



War-developed electronic navigation puts sextant in the nautical museum.

By LT. COL. N. F. SILSBEE and DEVON FRANCIS

A COUPLE of pencil points of light on a fluorescent screen, measuring time in millionths of a second, have given airplanes and surface ships, for the first time in the history of navigation, a means of plotting their positions almost instantaneously. A navigator fast with his fingers can find out where he is in less than 30 seconds.

This war-born system is called "Loran" (LOng RAnge Navigation). It is in the radar family of war miracles. It helped bombing planes dump their loads smack on Nazi installations at night and was fully as accurate for bombing at medium distances as radar's Plan Position Indicator. (PSM, Sept. '45, p. 65.)

With Loran, warships were able to pinpoint their positions on the ocean and methodically comb areas where U-boats were reported. With Loran, American bombers operating from weather-bound Aleutian bases struck at the fogged-in Jap Kurile islands. With Loran, aircraft and surface vessels en route between continents could check their courses at any moment even though clouds obscured the sun and stars.

Typical of the reports after the system was put into operation was: "By means of Loran, a transatlantic convoy made a perfect landfall following a three-day storm in which no reliable celestial fixes were obtained."

Loran is an electronic navigator. It consists of a series of transmitting stations on prominent points of land along a coast, the receiving equipment carried by aircraft and ships, and some charts. All that a man needs to operate it is good eyesight, a pencil, and the ability to add.

It differs from any other kind of navigational equipment in that the messages it transmits carry no clues to direction. Hence, it was especially valuable during the war. Without charts keyed to signals sent out by stations on land, the system was useless to the enemy. Moreover, an airplane or a ship did not have to ask for the "fix" by radio

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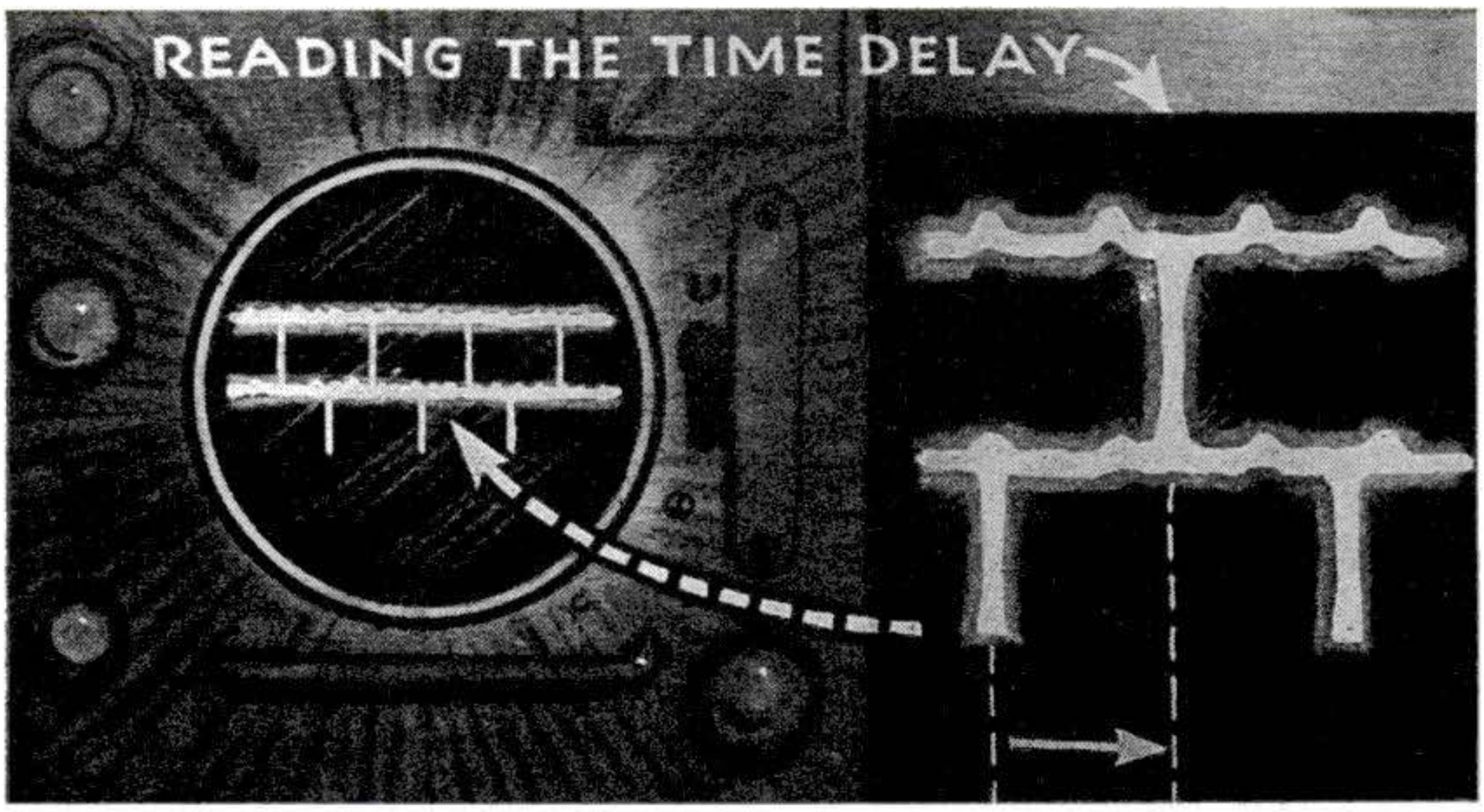

Receiver has done its work and signals from stations are wiped off face of oscilloscope. In their place, by turning controls, the operator puts scales by which he reads time delay. He takes three readings—coarse, medium, and fine—to obtain the utmost in accuracy.

and thereby betray its position. The signals went out as regularly as clockwork without bidding. And that is what makes Loran so valuable in peacetime: it never sleeps.

It differs from all other systems of navigation in that the mechanism itself is only a time-measuring instrument. Its secret is the measurement of infinitely small pieces of time visually, so that the eye can interpret those measurements in terms of position.

The Loran radar set in a plane or ship receives signals from two stations. One station is the "master." The other is a subsidiary station, a "slave." An oscilloscope measures the difference in time, if any, that it takes for the two signals to reach the airplane or ship. That is where the charts come in. If the time is identical for both, the airplane or ship must be equidistant from each. That is, it must be on a line drawn on a chart perpendicular to and at the center of another line connecting the two sending stations. If the time differs, however, the airplane or ship must be nearer one station than it is to the other.

The charts have nothing to do with standard parallels and meridians. All they show are lines where the time lapse between any two sending stations is always the same. Regardless of distance, the time lag remains static. For every given time lapse and for every identical time for any two stations, a hyperbolic line is drawn on a chart. The lines represent distances up to 1,500 miles, the maximum at which the signals are useful.

Using the time measurement between two stations, the navigator plots his position on one of the lines. At this point, a navigator using a conventional aural-directional "radio fix" system based on triangulation would be able to plot his approximate position, weather conditions permitting. But with Loran the navigator's task is only half done. He tunes in on two more stations by turning a knob, gets the time measurement on them and finds the curve that fits. The intersection of his first and second curves shows him where he is and, if he wants to, he then can interpret that in terms of latitude and longitude.

All this would be simple if the signals from any two stations differed in wave length, but they don't. They "pulse" on the same transmission frequency. So some method is needed to identify the "master" and the "slave." Loran does this mechanically by making the "slave" transmit its pulses 20,000 microseconds (or 20,000 millionths of a second) behind the "master's" pulse.

Since all Loran transmitting stations pulse on the same wave length, a method is also needed to distinguish between each pair of stations. Variations in the number of pulses a second make this possible. Station pairs differ only slightly on the pulse rate. They vary from 20 to 33 a second. But the receiving equipment is adjusted to respond to those slight differences.

The screen on which Loran's time measuring is done resembles a radar "A" 'scope with horizontal indication, as contrasted to the Plan Position Indicator circular 'scope with its maplike indication. "Pips" of light move across it when Loran stations are tuned in, and from the positions of the pips the time measurements are taken.

Navigators now swear by Loran. A war correspondent on his way back from the Pacific in a transport plane peeked into the navigator's cubbyhole to watch the man plot his course. Part of his equipment was a sextant—a navigator's best friend for more than 200 years.

"I'm supposed to use this thing once in a while to keep my hand in," the navigator said with a grin, "but if I want to know where I am and where I'm going, I just glance at the Loran 'scope."

Loran works in rough seas and rough air, where a man would have a tough time using

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a sextant. Only near-by lightning or severe "precipitation static" — caused by rain or snow — will render it inoperative and then only momentarily. Over water, Loran can obtain fixes accurate to within less than a mile at distances up to 750 miles in the daytime and 1,500 miles at night. Reflected "sky waves" from the ionosphere increase the distance at night, just as they enable a home radio to pick up stations at greater distances after sunset.

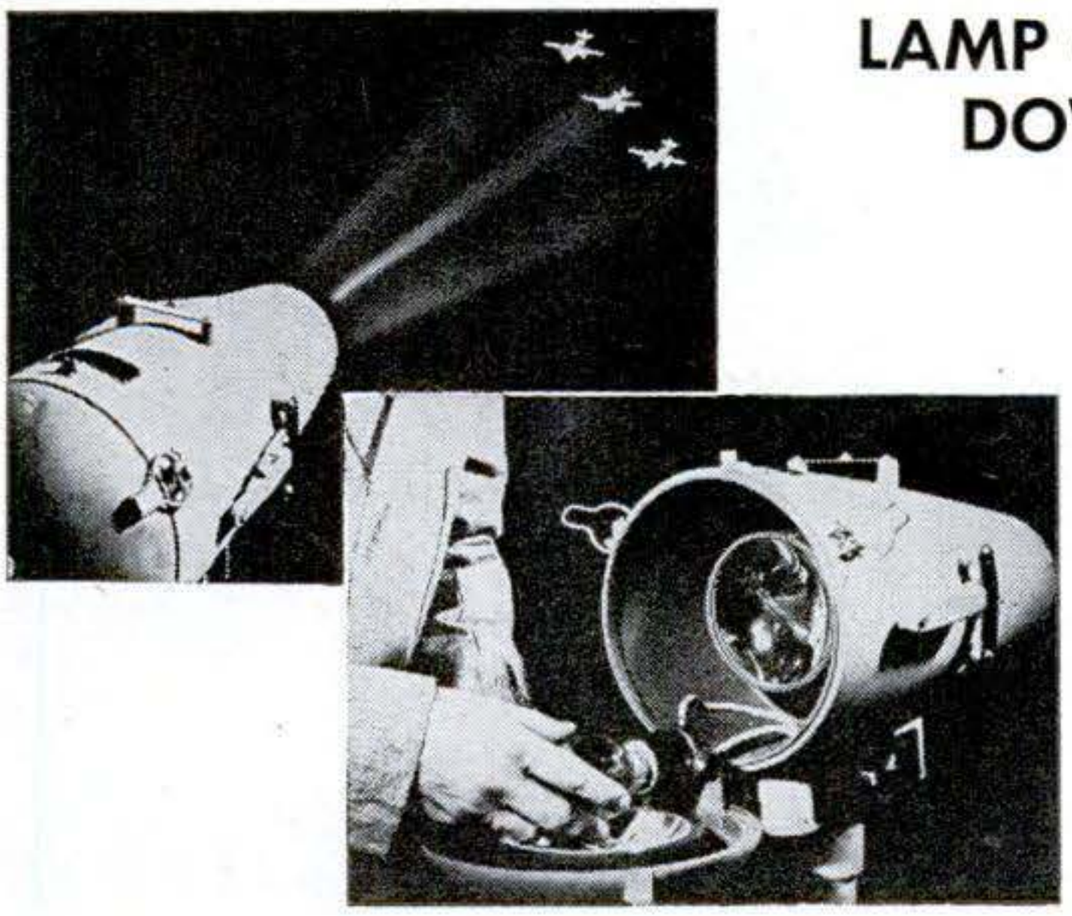
In speed of use and accuracy Loran is called far superior to any other system of navigation — celestial, radio triangulation, radio beam, and, indeed, other adaptations of radar. It is far and away better, of course, than such devices as dead reckoning. But it has had its drawbacks. The equipment at first was relatively large and heavy, although it is now simplified and lightened. The air-borne receiver weighs less than 40 pounds, or half what it did.

Loran also is expensive. It took $100,000,000 to get it developed and installed, and trained personnel is required to maintain the ground stations. But its functional simplicity and accuracy make its peacetime use a certainty. The British have adopted it outright and recommended its international application. The Provisional International Civil Aviation Organization, composed of government representatives from 54 nations, has endorsed it. And Lt. Gen. Ira C. Eaker of the Army Air Forces has stated that the largest amount of AAF aeronautical equipment other than aircraft to be used in the immediate future will be for an extension of the Loran system. That system already covers a third of the earth's surface, and more than 2,000 surface vessels of the United States, Canada and England, and scores of thousands of aircraft are equipped with Loran receivers.

Loran was developed by the Radiation Laboratory, at the Massachusetts Institute of Technology. It was based originally on a proposal made late in 1940 by Dr. Alfred L. Loomis of New York, head of the National Defense Research Committee's "Microwave Radar Committee." Dr. Loomis did not know the British were at work on the same thing. Then Sir Henry Tizard, head of a British scientific mission to the United States, dropped a hint about their research in the field. The British effort resulted at length in the development of a cousin to Loran, a short-range navigation system known as "Gee," and Sir Henry's remark was enough to confirm Dr. Loomis's belief that he was on the right track. The development work at M. I. T. was directed by Dr. Lee A. DuBridge, head of the NDRC Radiation Laboratory. While Loran and "Gee" are in the radar family, they are not radar as it is commonly known, since they do not use reflected radiation or "echoes."

Maj. Gen. Curtis LeMay, who ran the Superfortress strategic-bombing show against Japan from the Marianas, reported that with Loran navigation his planes, flying the shortest distance between base and target, had been able to cut down their gasoline reserves and carry extra bombs. Methodically searching sea areas by following hyperbolic curves on the charts became known as "Loran lawn-mowing" and accounted for a lot of subs.

LAMP GUIDES LANDING PLANE SAFELY DOWN PATH OF COLORED LIGHT



An approach angle indicator, its lamp and reflector revealed in photo at right, illustrates with model planes how it works. Center plane is coming down correct beam; pilot in it would see green light only.

AIRPLANE pilots soon may be able to ride down paths of colored light to safe landings, without even looking at a runway. Military tests of an approach angle indicator, developed by Westinghouse engineers, have proved it to be a useful aid to aviation safety.

The indicator consists of a 100-watt lamp with several lenses, pieces of colored glass, and a strong reflector that enables it to be seen five miles away. It forms three sharply defined wedges of light over a runway: a six-degree red beam, a two-degree green beam, and an eight-degree amber beam. The indicator is effective except in heavy fog and can be used alone or with radar.

A pilot can descend at a constant and safe rate if he rides his plane down the green beam.

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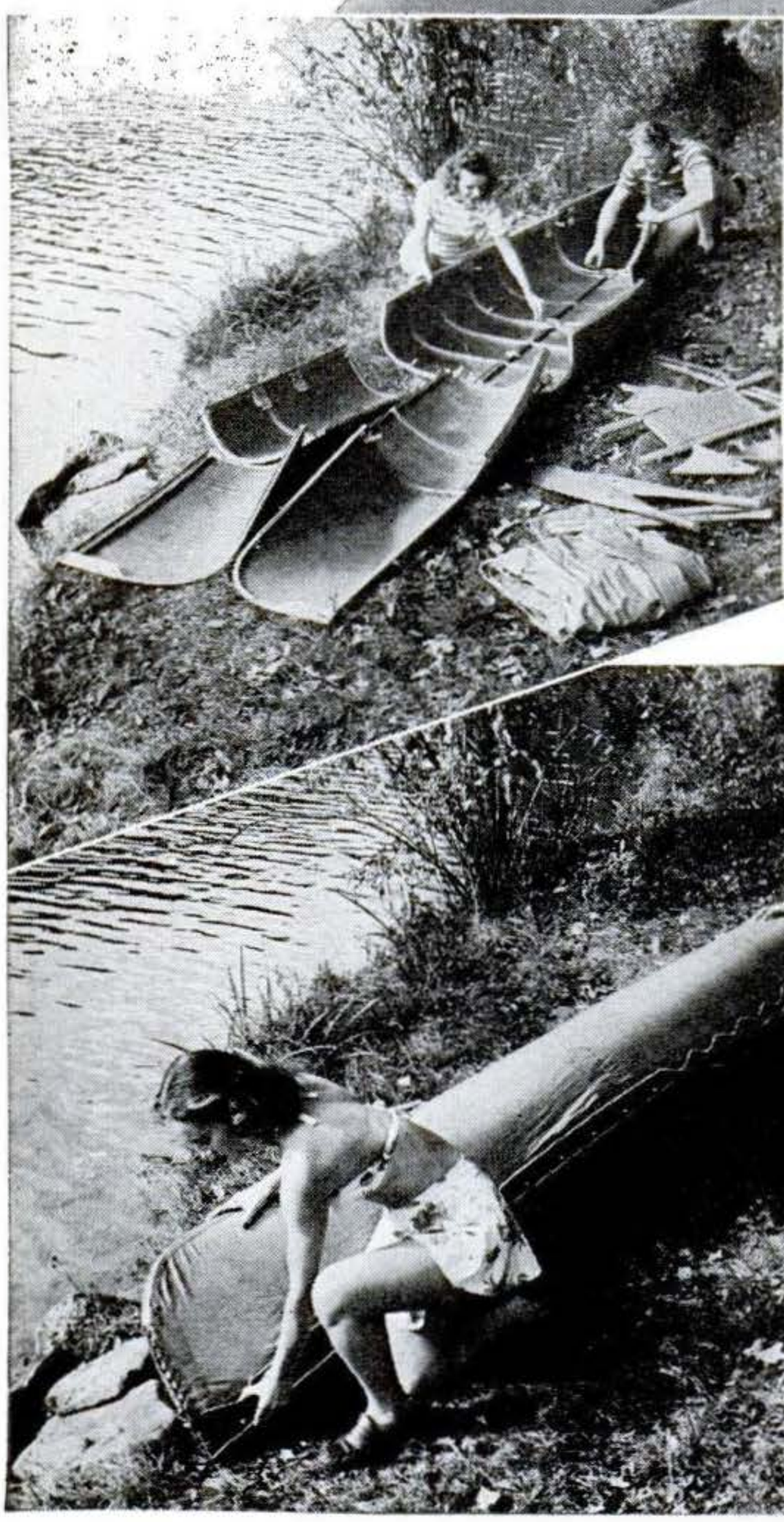
SECTIONAL CANOE IS



ED LINK, the man who invented the famous earthbound training machine for instrument flying, got vexed one day because he couldn't find a satisfactory collapsible canoe that he could tote along with him on hunting and fishing trips. So he designed and built one of his own.

The Linkanoe, as he calls it, is made of molded plastic and weighs only 65 pounds. Broken down into 10 sections, it can be carried in a couple of zipper bags. It is nonabsorbent, will not warp, and is impervious to salt water and gasoline. It can be assem-

The Linkanoe's 10 sections are quickly and easily put together (upper left). Specially designed metal clamps lock the various-shaped parts.

A canvas skin pulls snugly over the hull and is held in place by elastic airplane shock cord. Completely watertight, the full-size 14½-foot canoe can bear a normal load of passengers or equipment.

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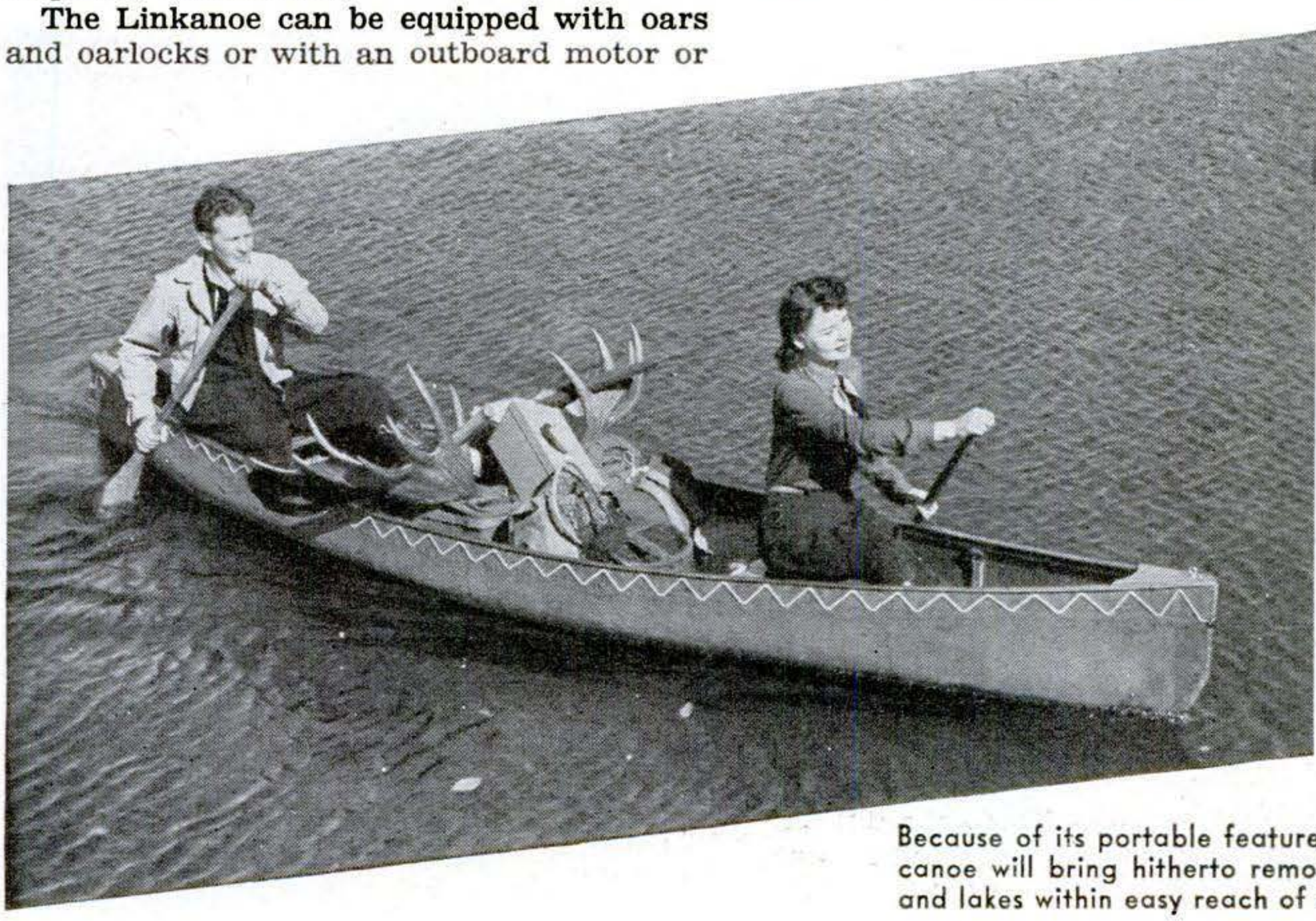
EASY TO CARRY

Stowed in two zipper bags, the 65-pound come-apart craft is handily carried. Paddles form the grips.

bled in less than 10 minutes and held together by special metal-locking clamps. Link achieved waterproofing by putting the craft in a canvas sheath that fits tightly over the hull and is held in place by elastic airplane "shock cord."

The Linkanoe can be equipped with oars and oarlocks or with an outboard motor or rudder attachment. Both fore and aft decks contain metal compartments in which fishing tackle, ammunition, or first-aid kits may be stored. As a final touch, Link made even the paddles sectional. They come apart and are used as handles for the zipper bags.

After tests on some of Canada's roughest waters, Link feels confident the craft will match the performance of any conventional canoes now on the market.



Because of its portable features, the new canoe will bring hitherto remote streams and lakes within easy reach of sportsmen.

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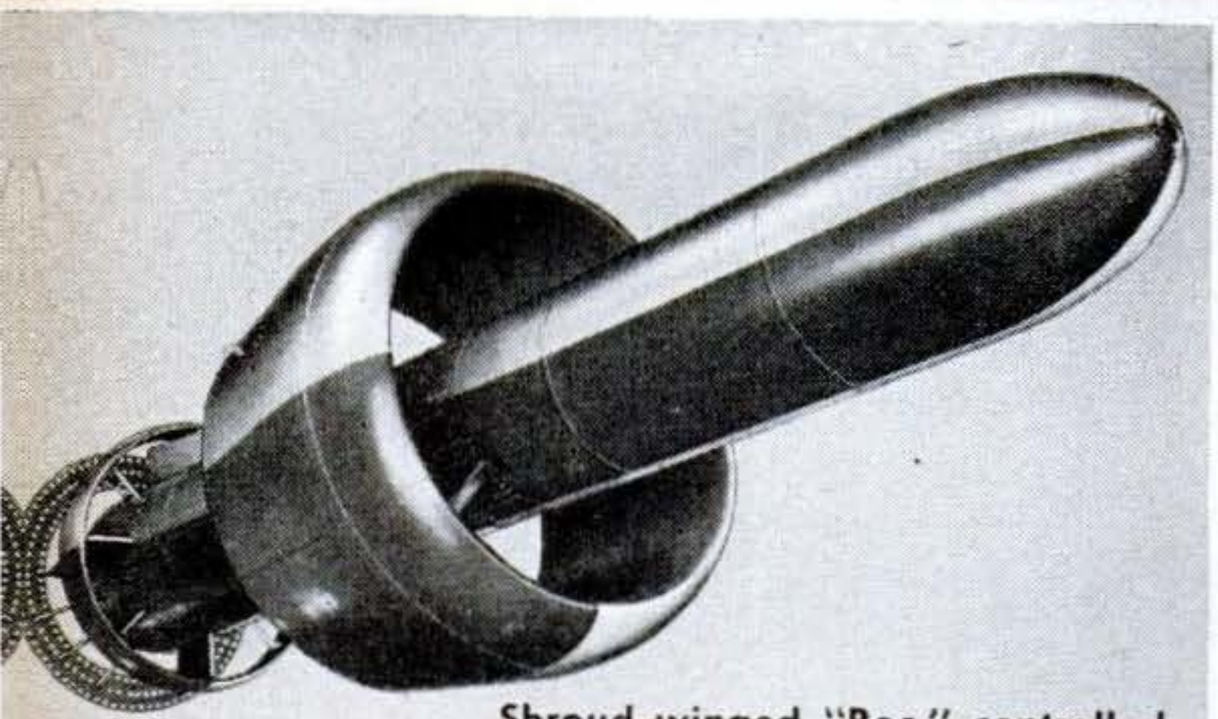
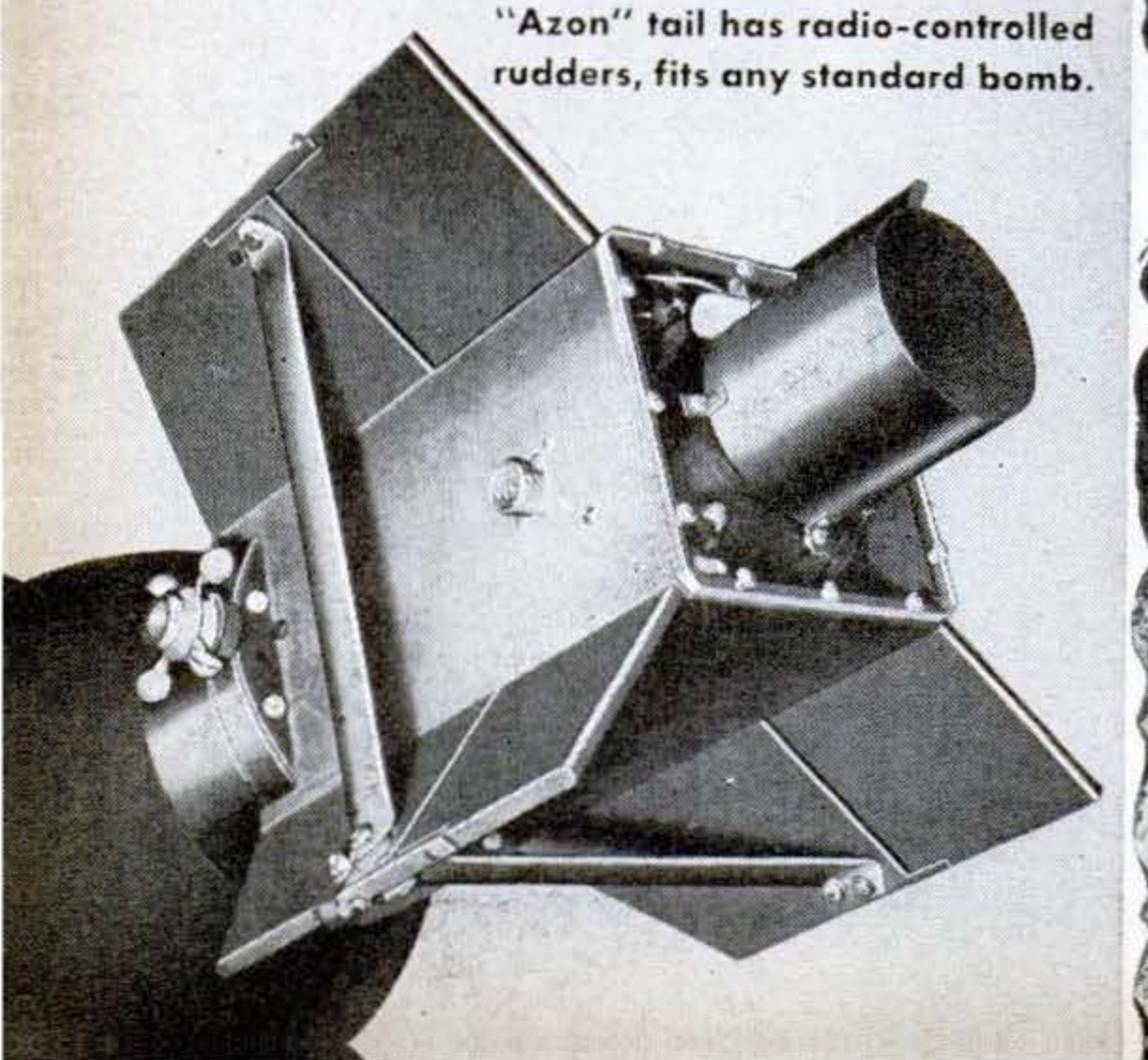
Navy's 10-ft. "Gargoyle" bomb dives at 600 m.p.h. and carries 1,000-lb. warhead in its slim 26-in. cylinder.

Rocket-propelled "Gorgon" IIA, air-to-air missile of tail-first design, has 100-lb. charge, goes 550 m.p.h.

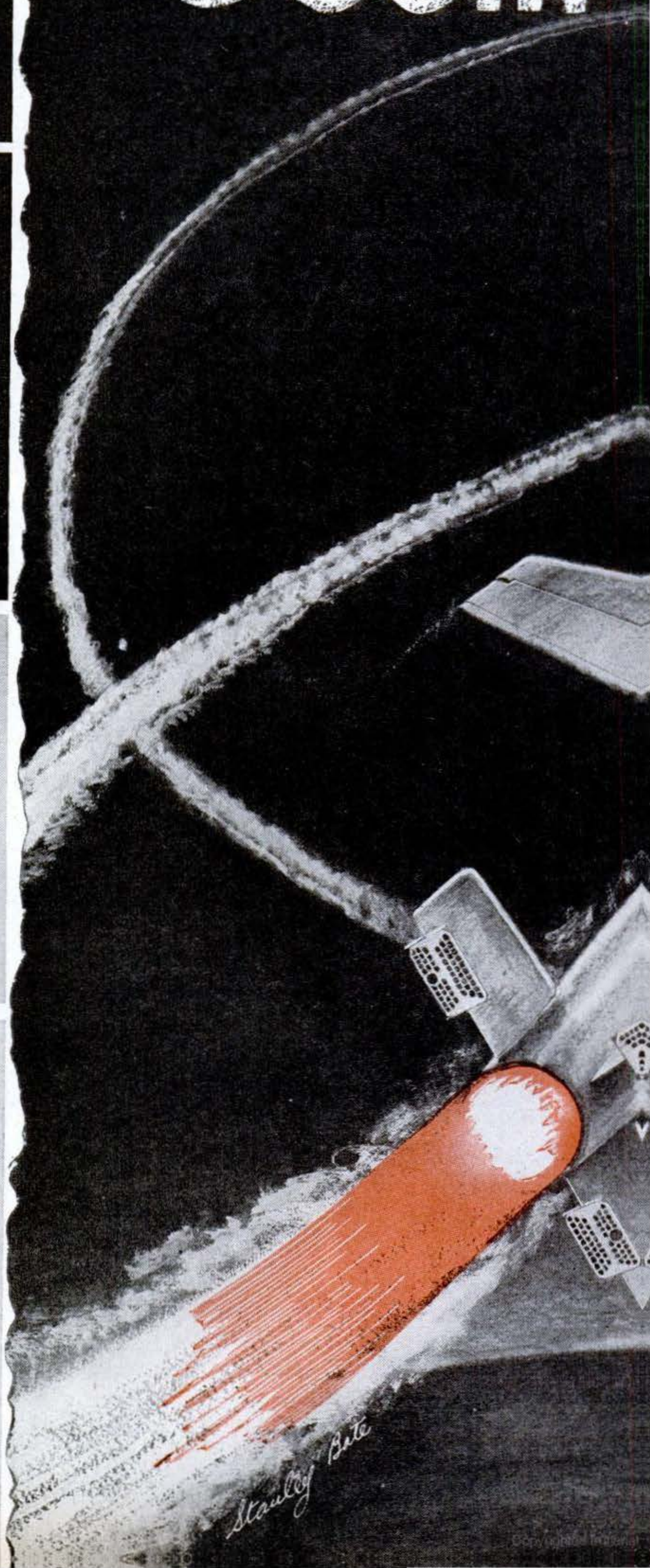


Shroud-winged "Roc," controlled by radio, is guided by television.



"Azon" tail has radio-controlled rudders, fits any standard bomb.

Doom



Stanley Bate

on the Wing

New missiles aim themselves at light, heat, or metal

"While this country must employ all its physical and moral force in the cause of peace, it must recognize that real security against atomic weapons will rest upon our ability to take immediate offensive action with overwhelming force."—Gen. H. H. Arnold.

By JAMES L. H. PECK

FELIX is a sleek and sullen cylinder lying quietly in a wheeled cradle. His head, apart from Felix, is poised on a ball-bearing turntable. As you enter the vast hangar where Felix and his friends are housed, the head points at you, and continues to point at you no matter how quickly you turn, advance, or step back. In the same manner Felix, with his head attached, will turn, point to and finally destroy a heat-giving target. For Felix is a heat-seeking missile. The slight heat of a human body

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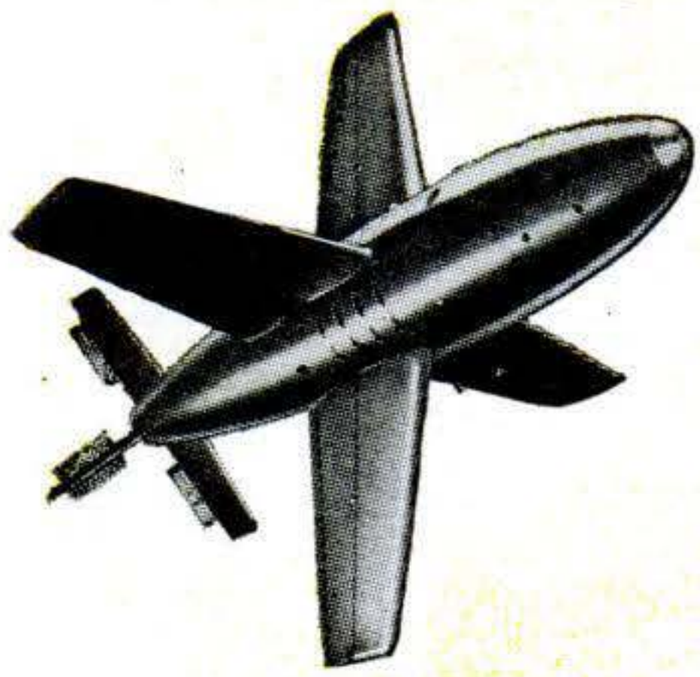
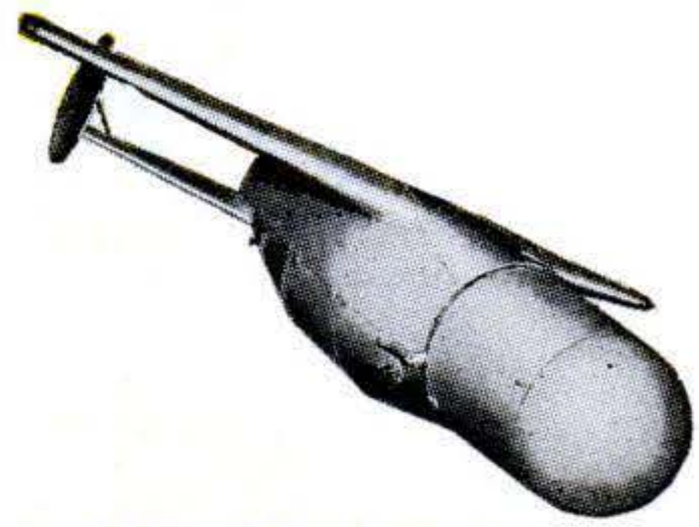


"X" missile, 25 ft. long, can operate like a "Roc" or be self-guiding seeker.



"Bat," radar-guided bomb, finds its way accurately through fog and darkness.

in a huge hangar is enough to activate the sensitive thermopile in his nose.

Guided unerringly by this nose for warmth, a barrage of such missiles could wipe out a nation's furnaces and foundries, could seek and destroy other jet or rocket missiles or planes.

Then there is the light-seeker, a highly intelligent robot available in two models. One, designed in Wright Field's Controlled Equipment Laboratory, will aim itself at marker flares or delayed-action fires started by espionage agents to put a fiery finger on vital enemy targets. Rockets and bombs fitted with this super-photoelectric eye can "see" any stray light in a blacked-out city as well as lights planted purposely to guide them. The second type is the "light-sensitive" model, which will hurl itself toward a light target on a dark background, or toward a dark object on a light background.

The magnetism-seeker is another type of guided missile. It is attracted by any great mass of steel, such as a ship, bridge, or tank. Each of these amazing target-finders is adjustable to a remarkable degree prior to launching, and can be made sensitive to any source of heat, light, or magnetism.

Radar, the military's sixth sense and the most generally useful weapon of World War II, is playing a significant role in guided-missile techniques. A recent Navy statement predicted that research and development programs will produce "airborne radars that can initiate defense, and automatic circuitry that can release the airborne countermissile."

Two interesting schemes are suggested. A radar-equipped interceptor, either piloted or pilotless, may be dispatched to patrol a certain part of the stratosphere or ionosphere for enemy missiles. If one is located by the patrol ship's radar, a rocket will be sent off immediately and automatically to intercept that missile. It will use the focused radar beam of the interceptor as an invisible trolley line to the target. The second suggestion is that airborne radar equipment be compactly installed in the noses of the missiles. They then would be launched by means of a triggering circuit as soon as the ground or ship-warning radar detected an enemy missile, and would guide themselves on collision courses with the enemy just as night fighters were guided toward enemy bombers in the Pacific.

This electronic legerdemain does not seem too advanced to persons who know that the AAF already has bombs that behave in a similar fashion, and that the Navy sank many a Jap vessel with its radar-guided "Bat" missile. The winged RHB (Radar Homing Bomb) can be guided downwards along the beam of its bomber's search radar, or aim itself at an enemy radar installation, or hurl itself toward a small "Eureka"-type beacon planted secretly by saboteurs. And the SRB (Seeking Radar Bomb) carries its own compact radar that locates and guides it towards moving or stationary land or sea targets.

The Navy's 12-foot, winged radar bomb operates in the same manner. They call it the "Bat" because it finds its way around in the dark, emitting supersonic noises that echo back from obstacles in its path. The "Bat" and the SRB find their targets even in fog or darkness and are guided, along their own radar beams, toward even a fast-moving object.

Television is another means of guiding missiles. Bombs, rockets, or pilotless aircraft have been fitted with compact television cameras that serve as eyes to see where they are going. The bombardier or ground operator miles away can watch in his small television screen the course of the missile he is controlling and alter its course by radio control, to guide it to the target he sees on the screen. This long-distance vision and radio control eliminate the need for suicide pilots.

New strategical and tactical doctrines are needed, because any point on earth will be vulnerable to attack from any other location. Instead of great bomber bases, we may

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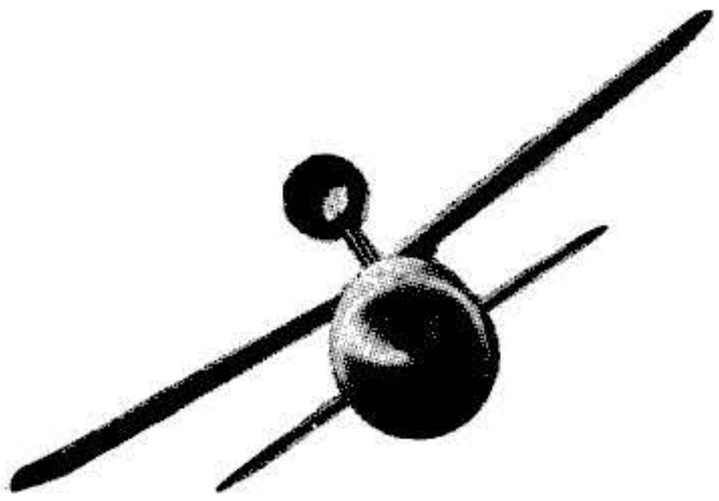
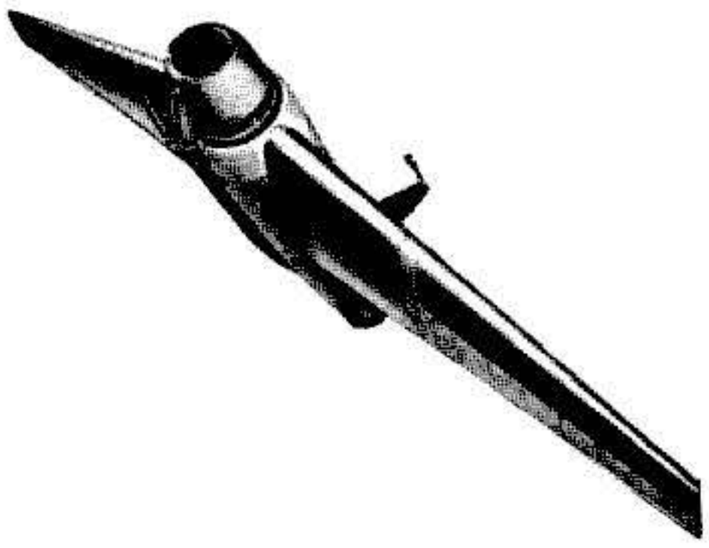


Wind-tunnel model of the Navy's swift "Gorgon" C, a new jet-propelled bomb.



Flying-wing buzz bomb carries explosive charge in wing, travels 425 m.p.h.

have "offense control centers," and in the place of fighter airdromes we may need "defense control centers" that will be relatively small and closely spaced along the coastlines and in depth.

The Japs' Baka bomb was the only true guided missile employed in the war that just ended. Suicide pilots are gone with the divine wind now—and so are the rockets that were designed to be aimed at specific targets and for flight along straight courses for a fixed period of time. Terrifying though V-1 and V-2 were, they were limited tactically by lack of accuracy. New remote-control devices and self-aiming apparatus will enable the missiles of the future to fly a curved or zigzag course, if necessary, to hit the smallest target.

Increasing precision may, in time, revolutionize military method to the point where maximum tactical effort can be achieved by one military force against another with a minimum of material and manpower. Until now, all-out war has meant throwing everything at hand at the enemy. Guided-missile warfare may be much cheaper—the cheapest kind of fighting, in fact, that humanity has ever been cursed with. The greater part of the cost will be for research. Many sciences are involved in the development of these robots, and they are neither planes nor projectiles, but weird-looking combinations of the two.

The development of American guided missiles goes back to the time of Pearl Harbor, when a 20-foot, 200-horsepower, pilotless airplane was being test-flown over Muroc Dry Lake, California. Such tests and subsequent research led to the perfection of radio-control methods that permitted fliers to guide larger "drones," and even Fortresses and Liberator bombers, from mother planes. (PSM, Dec. '45, p. 93). Pilotless aircraft, however, are but one of many types of guided missiles.

GBs (Glide Bombs), VBs (Vertical Bombs), and GTs (Glide Torpedoes) also were used by the AAF in the last year of the war. The GBs permitted the Fortresses to bomb the heavily defended city of Cologne from a distance beyond the reach of Nazi antiaircraft. The VB-1, AZON (controllable in AZimuth ONly) bomb, which had radio-controlled tail fins for left or right steering, was used to destroy the Aviso viaduct near Rome. VB-2 and VB-3, RAZON bombs (controllable in Range and AZimuth ONly) were improved models, with which bombardiers could make corrections for "shorts" or "overs" as well as side errors, and these were on the way to the Pacific when the atomized Japs sued for peace.

GT-1s did plenty of damage to Jap shipping. One of these aerial tin fish, fitted with a wing and tail assembly, was carried by Mitchell medium bombers and dropped out of range of antiaircraft fire. The GT glided at a 25-degree angle, dangling behind it a small paravane on a steel cable. When the winged torpedo hit the water, the sudden drag of the paravane tugged at the steel lanyard. This action fired two charges in "explosive bolts" holding together the steel bands that clamped the wing and tail to the body of the torpedo. The 2,000-pound tin fish shed its flying gear and sped for the target at which it was aimed. The GTs could be set for a normal torpedo run straight at the target, or could be adjusted, prior to launching, to run wild in harbors or narrow channels. In the latter case, the torpedoes would describe a hairpin pattern, cruising back and forth until they hit something. Or they would cruise in concentric, widening circles until they were stopped by some ill-fated Jap ship.

AAF technicians adapted the VB, GB, and GT missiles for control mechanisms and/or wing and tail assemblies that permitted the use of standard bombs and torpedoes we already had in use overseas. The VB "azons" and "razons" could be fitted with their special tails, for example, in about 10 minutes. And by taking advantage of this fortunate expedient we found it unnecessary to ship our newer, specially de-

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signed missiles to the theaters of combat.

Among these new missiles are the futuristic "Roc" bomb (shown on page 120) and the "X Roc," which has a cross-shaped (cruciform) wing. Both are fitted with televising equipment and radio controls. Navy contributions include the KA2N "Gorgon" IIC, a 16-foot, air-to-air missile of shark-like appearance that has its tail foremost. The 10-foot KSD "Gargoyle" is an air-to-surface missile that features a V-shaped "butterfly" tail and a stubby low wing. (The Navy uses its own designations for guided missiles. KA2N means: K—pilotless aircraft, A—aerial target, 2N—second model built by the Naval Aircraft Factory. KSD means: K—pilotless aircraft, S—ship target, D—manufacturer, McDonnell.) The Gorgon is rocket-propelled and radio-controlled, while the Gargoyle is a radio-controlled gliding bomb.

The missiles we used during the war, remarkable and deadly though they were, are in approximately the same state of development as was the bomber at the end of World War I. Science, however, now is progressing more rapidly than during the post-War I period. The new year's crop of missiles are as far advanced over the GB-1 as the B-29 was over the Martin "Twin" of the first World War. The weird forms and new aerodynamic features of the present missiles are the result of this rapid progress.

Missile design is gradually drifting away from the lines of the T-shaped airplane and approaching the form of the projectile. The wings are circular or X-shaped and feature new kinds of construction. There is the "plate wing," for example, in which the skin is fitted with internal rivets and wrapped around a simple metal framework. The electrically fired, explosive rivets are secured by internal riveting. The "solid" wing is a knife-edged, thin airfoil that is forged into a single piece. Another type of plate wing is a thin, cast airfoil whose ends are welded along the trailing edge like those of a hollow steel propeller. The telescopic wing for large missiles is another innovation, which will permit rockets of the V-2 type to glide great distances with power off. The wings may be extended by radio control, and retracted the same way, or shed by means of radio-fired explosive bolts prior to the rocket's descent.

Body forms of the new missiles no longer hold to the teardrop form once considered the aerodynamic ideal. Instead, there is a tendency to shape the head like that of an artillery shell, make the body cylindrical, and taper the tail like that of a boat. Such a form is required—and so are the thin knife wings—to surmount the compressibility-shock stall problems of supersonic speeds.

Science will benefit in many ways from the development of guided missiles. They may be used for stellar exploration in the near future. The ionosphere, that outer fringe of the earth's atmospheric layer, is considered by some to be science's last frontier, and we have only limited information as to what's up there. Missiles of V-2 type have been sent as high as 75 miles into the region of meteors and the auroras australis and borealis. An eminent scientist estimated re- *(Continued on page 207)*

Countermeasures are being urgently studied to fend off a barrage of huge missiles, sensitive to heat, light, and magnetism, that could be fired from across the ocean and wipe out our cities, factories, big ships.

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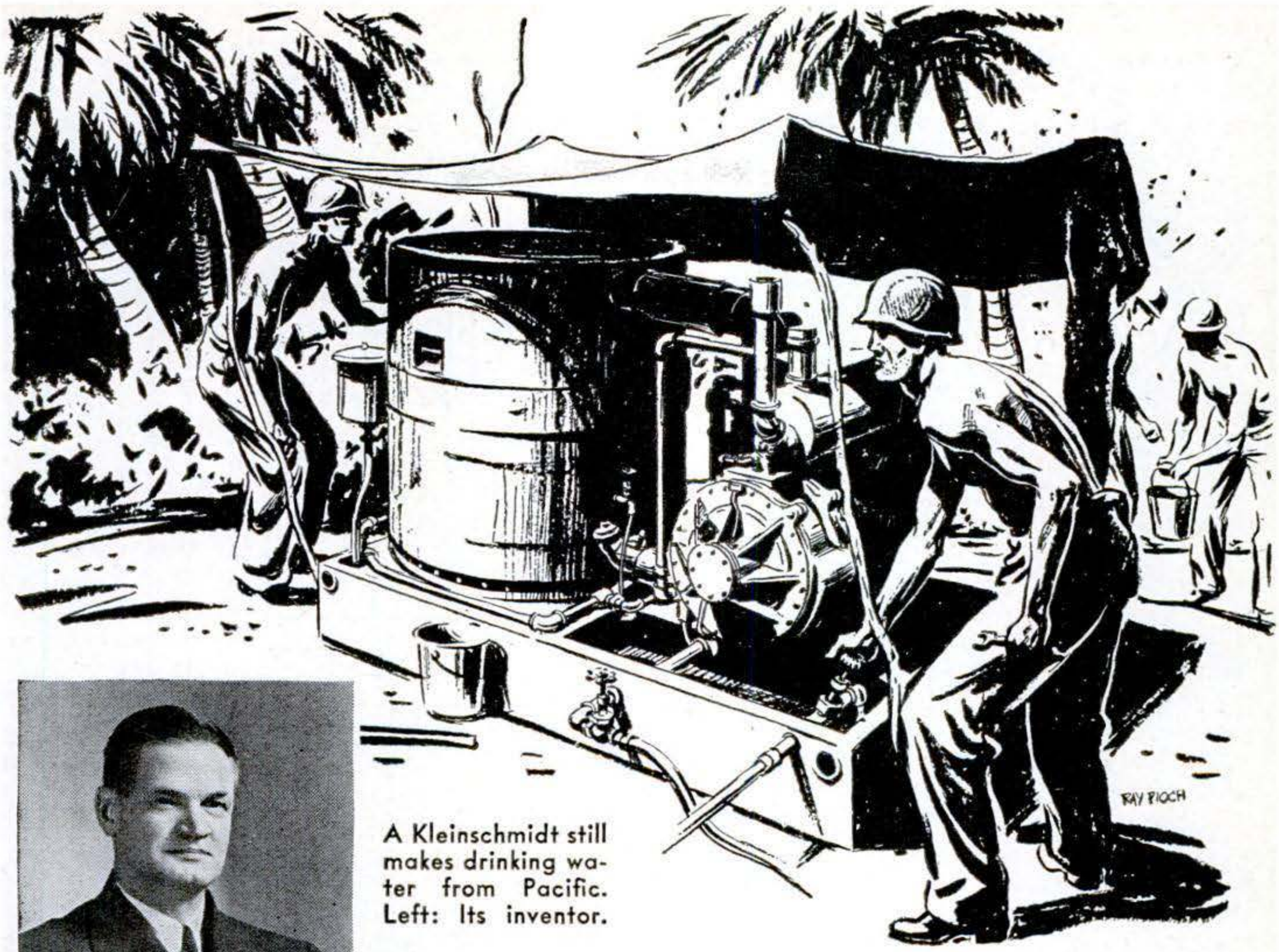

A Kleinschmidt still makes drinking water from Pacific. Left: Its inventor.

Navy's Compression Still Makes Fresh Water Cheap

TIRED and dirty war travelers, dropping down on the map-dots that were the airways steppingstones across the Pacific, would rush for the washroom to clean up. There, very often, the shuttling Army and Navy men and the war correspondents would see a crudely lettered sign:

BE CAREFUL OF OUR WATER—
IT TAKES A GALLON OF GAS TO
MAKE A GALLON OF WATER.

Gasoline or Diesel oil, of course, had to go out to these waterless islands by tanker, with the usual risks. And when the amount of fresh water available had to be measured in terms of equivalent gas or oil, even attack plans had to take that fact into logistics. Then came a new type of high-powered still that used a gallon of fuel to make 175 or more gallons of sweet water from the all-too plentiful Pacific, using new principles with peacetime applications.

The compression still, as it is called, was developed just before the war by Dr. (later Commodore) R. V. Kleinschmidt, working in the laboratories of Arthur D. Little, Inc., at Cambridge, Mass. The idea of distillation using compression was not new, but Dr. Kleinschmidt worked out the means of making it work efficiently. He not only provided greater fuel efficiency, but a simpler still.

By the time hostilities ceased, it is estimated, enough units were in use to meet the daily needs of a million men. Many thousands were manufactured by E. B. Badger & Sons Co., of Boston. Many were used on submarines, destroyer escorts, and landing craft. The landing forces had them mounted on trailers or runners. A typical unit was about eight feet long and five feet high, consisting primarily of a power-driven compressor, a tubular boiler unit, and a series of tubes within tubes to recover heat.

The Kleinschmidt still is started by heating the salt water until steam is produced. In electrically driven units, this first heat is produced by a heating element in the boiler. When gasoline motors are used, the heat of the exhaust is used for this purpose. Once steam has been produced, the compression

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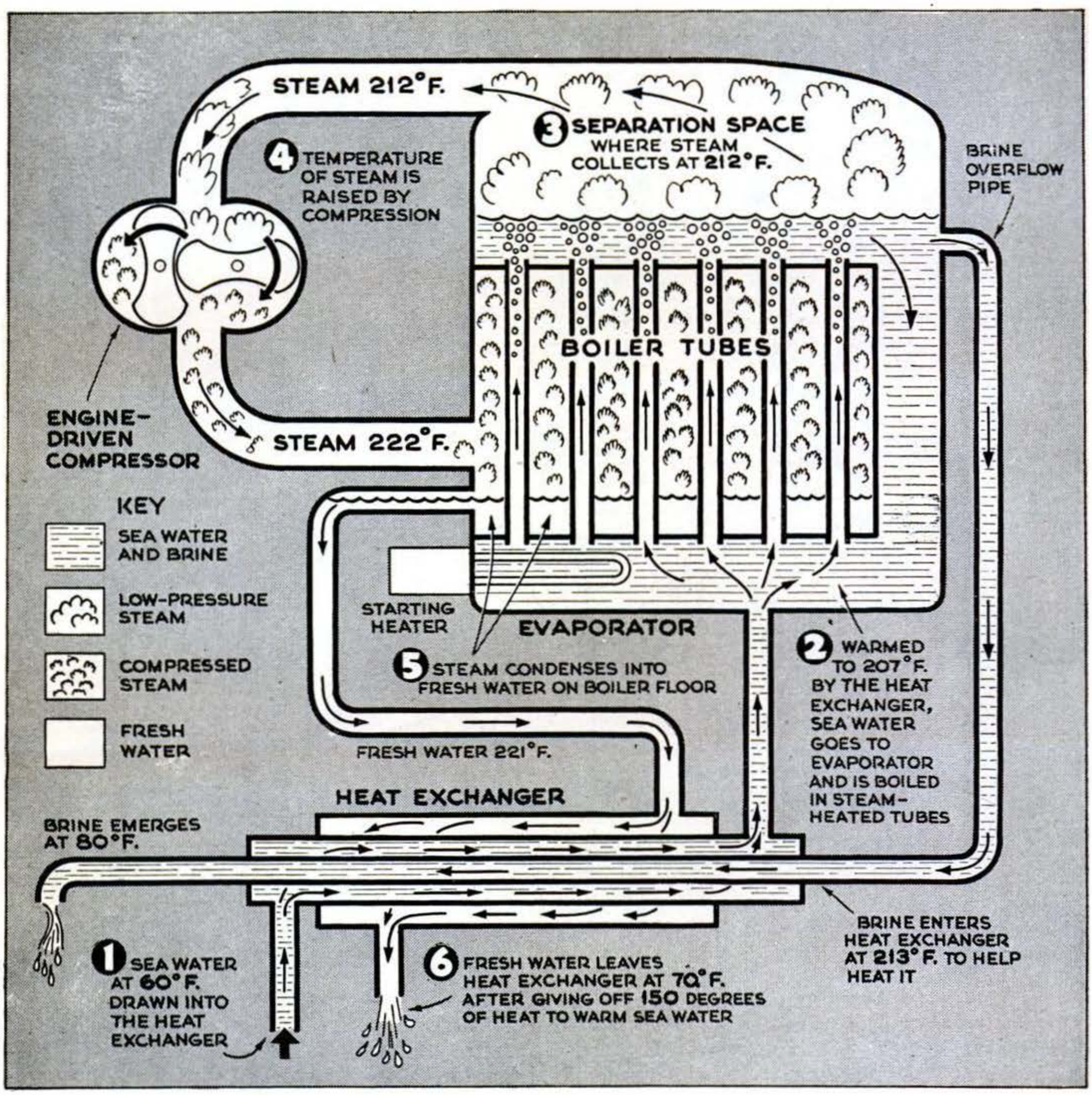

It takes only a gallon of fuel to produce 175 or more gallons of sweet water with the Kleinschmidt distiller.

built up within the system keeps it going without heat from any other source.

Steam at 212° F. is taken off the top of the evaporator and drawn through a rotary compressor. Here its pressure is raised to three pounds gauge, and its temperature goes up to about 222° F. Steam under pressure condenses at a relatively high temperature —in the compression chamber of the Kleinschmidt still, steam turns to water at around 222° F. This hot fresh water is run back through the evaporator and around the pipes containing incoming salt water and keeps it boiling. After losing some of its heat (about 15 degrees) to the salt water in the tubes, the fresh water passes out of the boiler. But, as it is now around 207°, it has work to do. It next goes to a heat exchanger through which the incoming brine is passing in the other direction. Here it loses heat to the cold salt water until, when it emerges, it is down to about 70°.

Through this same heat exchanger also passes about 20 percent of the salt water in the form of hot overflow from the still—that part not turned to steam. The heat is extracted from this also, and passes into the feed stream, so that by the time sea water has reached the evaporator it is already well on its way to the boiling point.

Such an efficient system will find important civilian uses. But one wartime use will carry over: the marine field, where economy in fuel consumption and saving of space are important. All industries involving distillation, either of water or other materials, can be considered possible users of the Kleinschmidt still.—GOLD V. SANDERS.

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NAVY'S *pin-up* BOXES

Those versatile pontoons the Seabees used will bob up in many ways in postwar ports.

By COM. W. MACK ANGAS, CEC, USN

SECRETS of the "magic boxes" with which the Navy's fast-working and hard-fighting Seabees performed waterfront miracles during the war (P.S.M., Aug. '44, p. 137) are now fully revealed for use in peacetime harbors.

The NL (Navy Lighterage) pontoon, which well earned its nickname of "magic box," was developed for the Seabees by the Bureau of Yards and Docks, and undoubtedly made possible some of their outstanding achievements. It enabled them to assemble quickly large floating units of many types from standard parts individually light enough to be shipped by steamer, rail, or truck. From NL equipment they built lighters capable of carrying up to 500 tons, powerful tugboats, self-propelled barges, floating cranes of as much as 75-ton capacity, floating pile drivers, wharves for ocean-going steamers, pontoon bridges for heavy traffic, and even fair-sized floating dry docks.

The basic idea of the NL pontoon is much like that of the toy construction set. Fundamentally, NL equipment consists of steel boxes or pontoons, assembling gear, and the large outboard motors, inboard propulsion units, winches, cranes, air compressors, pile drivers, Quonset huts, oil tanks, refrigerators, and so forth, needed to complete the floating construction units of which the pontoons form the supporting hulls.

The pontoons are of two types: One is a rectangular, welded steel box, 5 by 7 by 5 feet, used to build the central hull of a number of floating structures. The other is curved to make suitable bottom sections for bows and sterns of lighters and barges. The pontoons are internally braced and stiffened. Four two-inch plugged boiler flanges in one face of each pontoon provide pipe connections necessary for flooding and emptying, if it is used for salvage work or to construct a floating dry dock.

Stringing Pontoons into Barges

To build the hull of an NL pontoon barge or similar unit, the pontoons are first assembled ashore into strings, each of which is one pontoon wide and the full length of the hull to be constructed. The pontoons are connected by bolts and steel wedges to four steel angles that run the full length of the string and tie its component parts into a structure of great strength and rigidity. Enough strings are built to make a hull of the desired width. After the strings have been assembled and launched separately, they are floated alongside each other and connected by links, pins, and tie rods to form the complete hull.

Barges or other floating structures built of NL pontoons are classified by the number and length of strings used in their construction. Thus, a "4 x 12 barge" consists of four strings of 12 pontoons each.

Putting the Power On

To convert NL pontoon barges into self-propelled harbor craft, outboard units, which develop 115 horsepower, are bolted to their afterdecks. Inboard units, consisting of a 115-horsepower engine, reduction gear, propeller, and rudder are mounted inside a special type of end pontoon, which may be substituted for the regular end pontoon in one or more of the strings that form a barge.

The NL pontoon can easily be flooded, and later emptied by compressed air. This makes it useful for salvage and marine repair work. Pontoons, if floated and attached in sufficient numbers by divers to a sunken wreck, may be emptied by blowing the water out with air furnished by compressors, mounted on a pontoon barge, and may thus be used to turn or even raise the hull as a step toward its salvage or removal.

The same characteristic of the NL pontoon fits it admirably for assembly into a variety of floating dry docks. In such docks, the pipes for blowing out the pontoons are permanently installed and fitted with valves.

Ashore the pontoons have been used as storage tanks for gasoline and oil—and even as strongboxes for confidential papers, cigarettes, and beer.

Though the NL pontoon was employed by the Seabees to expedite the construction of naval bases, the specific ways in which the pontoons were used were often those in which a peacetime construction organization may use them.

See drawings on next page

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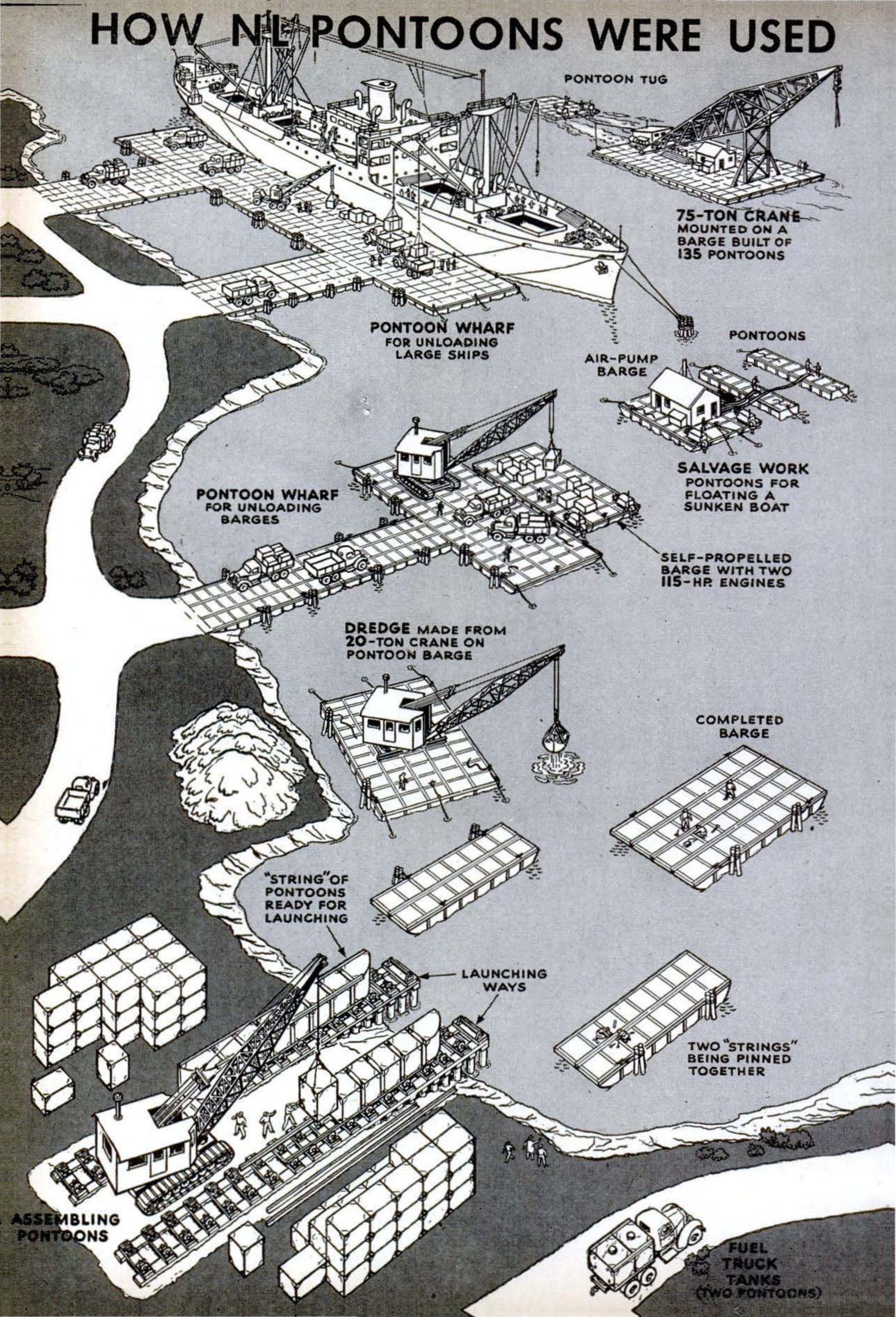
HOW NL PONTOONS WERE USED



ON WARTIME WATERFRONTS

SHIP UNLOADING ONTO PONTOON BARGES

PILE DRIVER MOUNTED ON PONTOON BARGE DRIVING PILES FOR PERMANENT WHARF

FLOATING BUNK HOUSES QUONSET HUTS ON PONTOON BARGES

PONTOON TUG TOWING PONTOON BARGE

AIR PUMPS

OIL & WATER BARGE (SELF-PROPELLED)

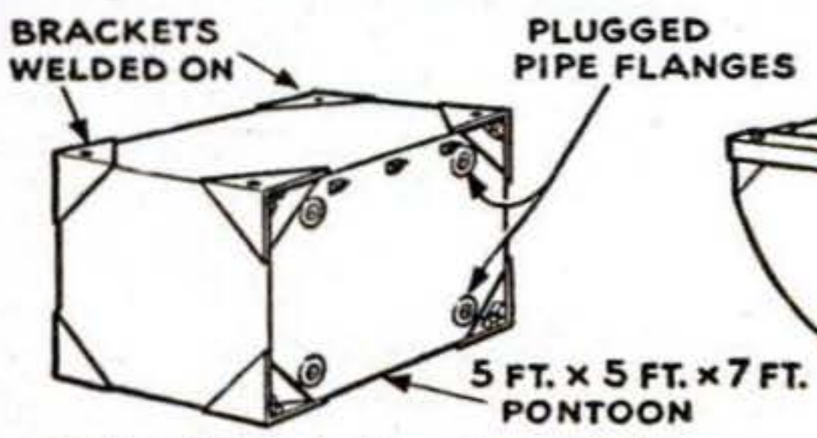
20-TON FLOATING CRANE ON PONTOON BARGE

PONTOON FLOATING DOCK

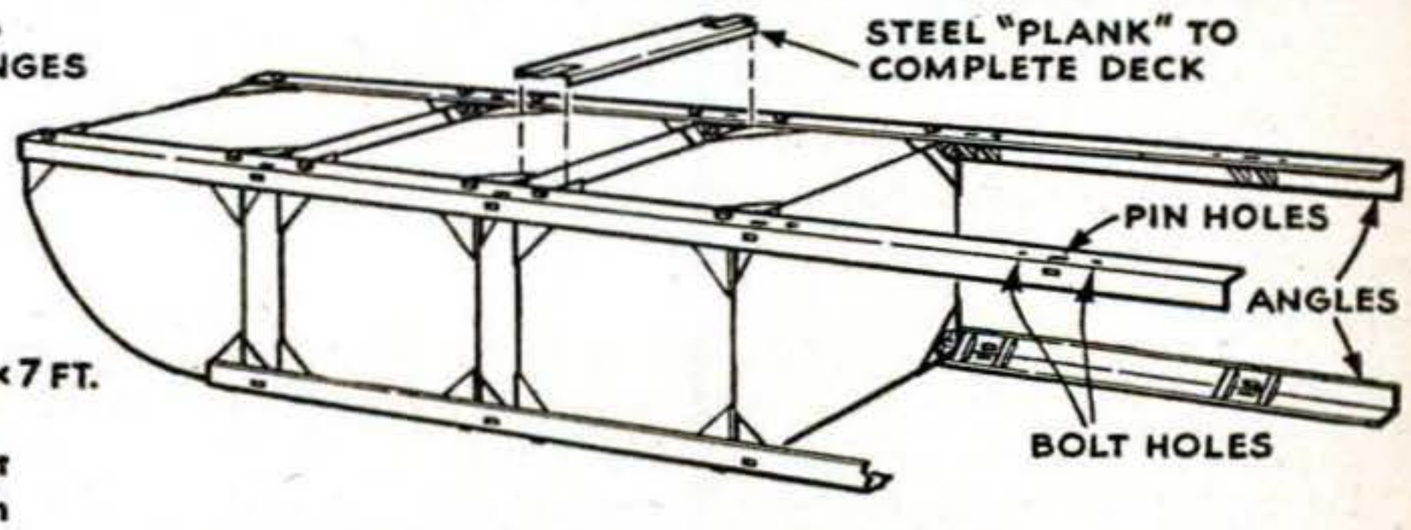
GASOLINE STORAGE

STEWART ROUSE

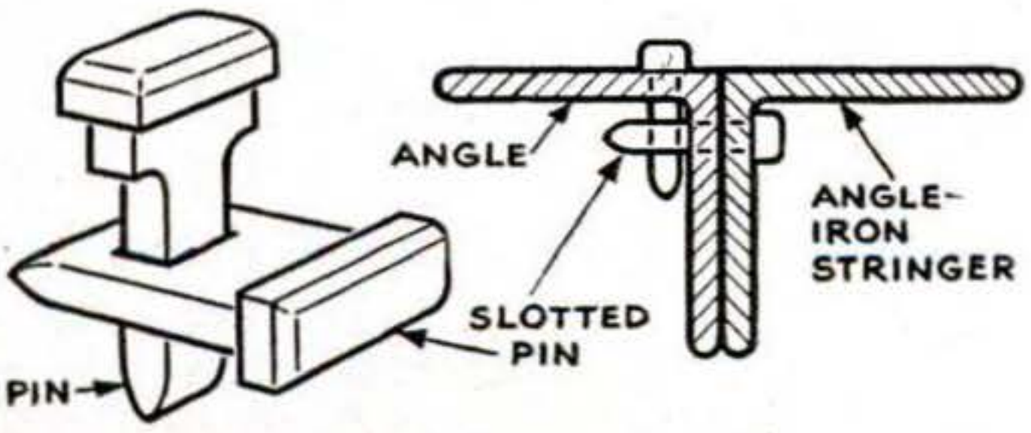
"PINNING" PONTOONS TOGETHER



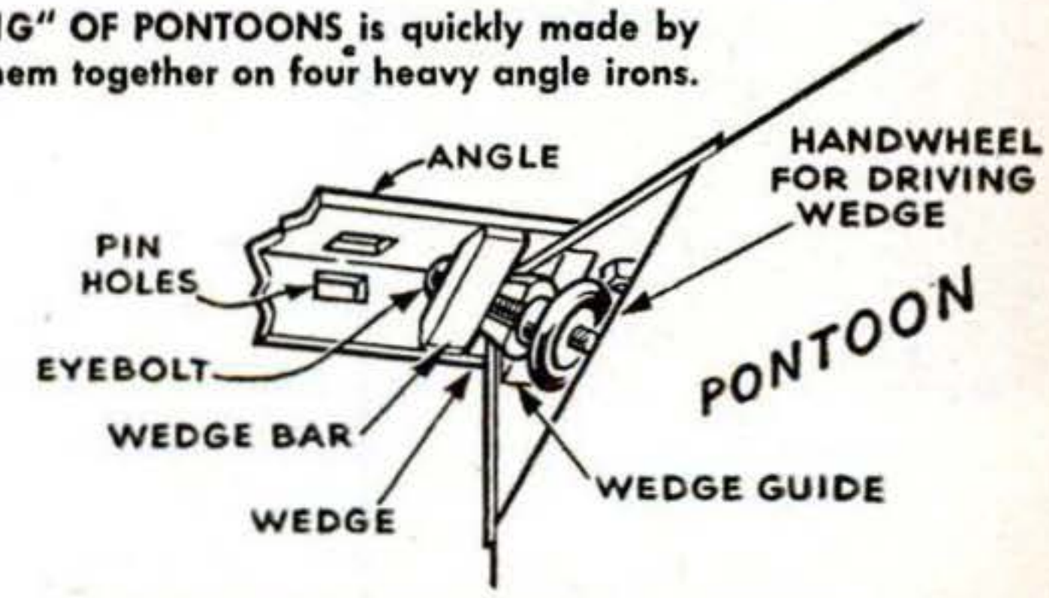
PONTOON is hollow box of sheet steel, triangle bracket welded on each corner. Bracket has bolt hole, with a nut welded to the inside of it.



A "STRING" OF PONTOONS is quickly made by bolting them together on four heavy angle irons.



ATTACHING A "STRING" TO A "STRING" to make a barge is done by mooring them alongside and linking their angle irons with driven pins (above).



TIGHTENING PONTOONS TO ANGLE IRONS is done at every corner by means of the above wedging device. Largest barges have tie rods to brace them.

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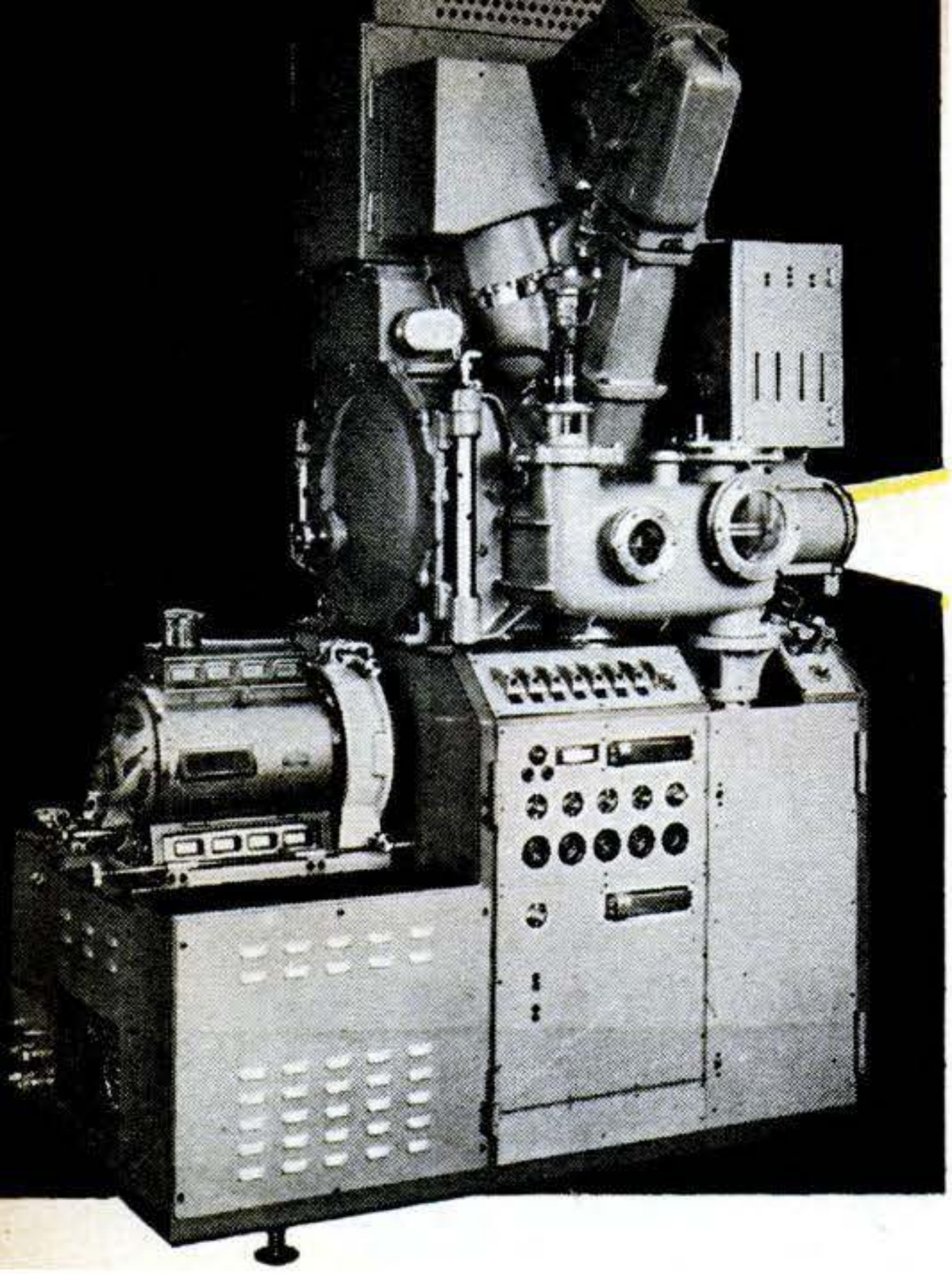

Swiss television camera, replacing end of cathode-ray tube with disk of oil, is eight feet high, weighs two tons.

"Idophore" process is new approach to problem of projecting theater-size images that are neither fuzzy nor faint.

Movies by TELEVISION

Swiss Use Film of Oil For Theater-Size Image.

By JOSEPH ISRAELS II

Special Dispatch to POPULAR SCIENCE MONTHLY

ZURICH, Switzerland—Television images have been projected on a full-size motion-picture screen at the Swiss Federal Institute of Technology by Prof. Fritz Fischer, with the help of a secret petroleum product.

This liquid is called "Idophore" and Prof. Fischer and his associates expect it to revolutionize the movie industry by permitting a single film to be shown in several theaters simultaneously. The problem they have been grappling with for six years was how to "blow up" the projected picture without diminishing its intensity or clarity.

The orthodox small-screen television receiver creates pictures by causing electrons in a cathode-ray tube to bombard a chemically coated surface. The surface on the end of the tube (the "screen") fluoresces rapidly as the electron gun shoots at it in response to the electrical impulses picked up by an antenna. The tube interprets the impulses in terms of lights and shadows and thereby creates the picture.

But the difficulty and expense of building vacuum tubes with fluorescent surfaces many feet in diameter have limited the size of the screens on which television shows can be seen. Television shows have been projected before theater audiences, however, by stepping up the size of the image with optical lenses and parabolic mirrors. Another method is known as the Scophony system. Instead of being used to make the end of the cathode-ray tube fluoresce, the stream of electrons is permitted to pass on through the end of the tube to a rapidly vibrating mechanical light valve that, like frames of movie film, permits varying amounts of light to pass through and create a picture on a large screen. In both systems the image has been either faint or fuzzy.

To compensate for the fuzziness or loss of light in increasing the size of the television image, Professor Fischer substitutes for the light created by chemical fluorescence an outside light source of the arc variety. To make the arc light produce lights and shadows, and therefore images on a screen, he replaces the end of the cathode-ray tube with a disk of film-thin oil. Bombarded by electrons, the oil sets up a miniature turbulence. This creates light refractions, faithfully interpreting the light and shadows transmitted electrically from the lens of the television camera. By passing the high-intensity arc light through the refractions in the oil, by a system of mirrors and lenses, the image is thrown upon a 24- by 32-foot viewing screen.

The oil disk is revolved and refrigerated. The revolving allows progressive portions of the oil to be "rested" and mechanically smoothed after being bombarded by electrons.

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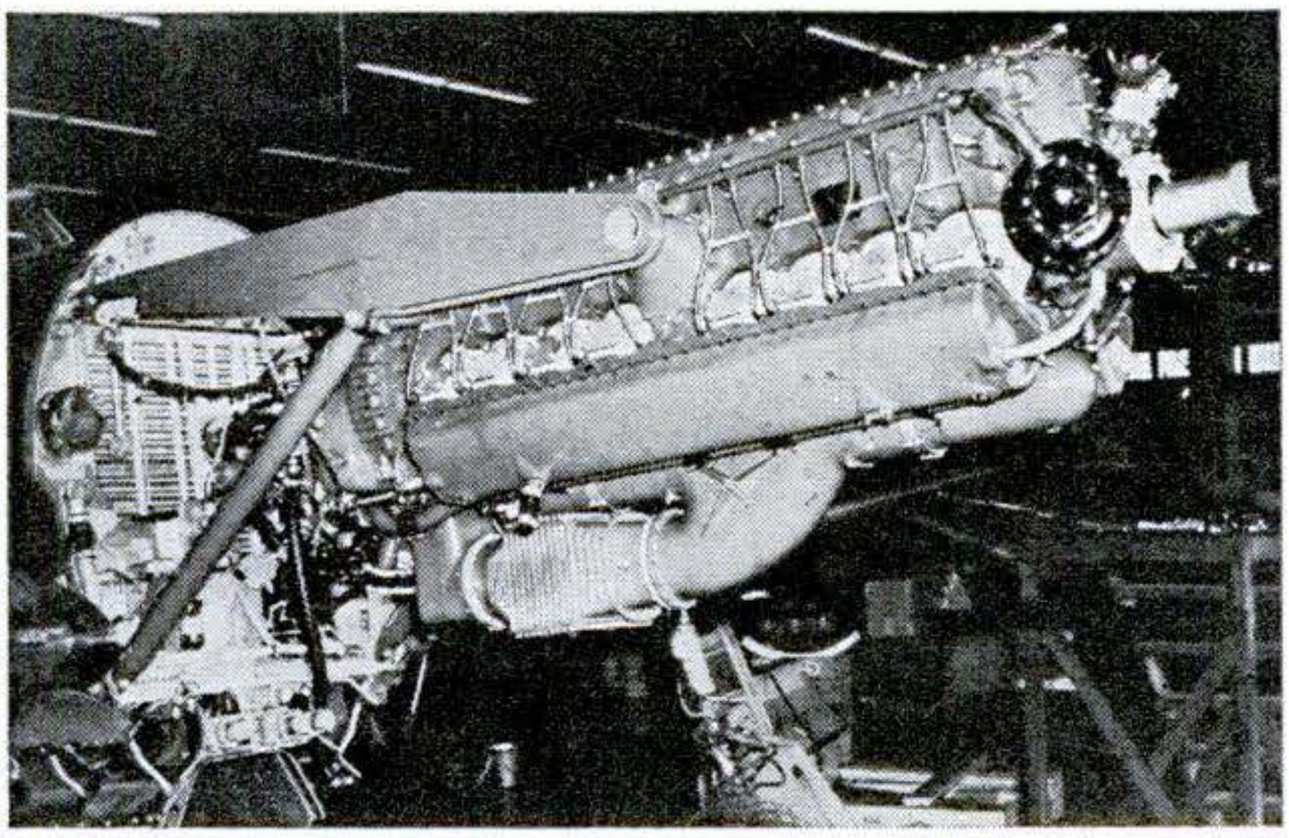
This is an artist's sketch of the Consolidated-Vultee superbomber which, with a peak gross load of 140,000 pounds, will have an operating radius of 5,000 miles, even more than the B-29. Powered by six Pratt & Whitney Majors (see below), the 163-foot-long ship will be manned by a flight crew of 17.

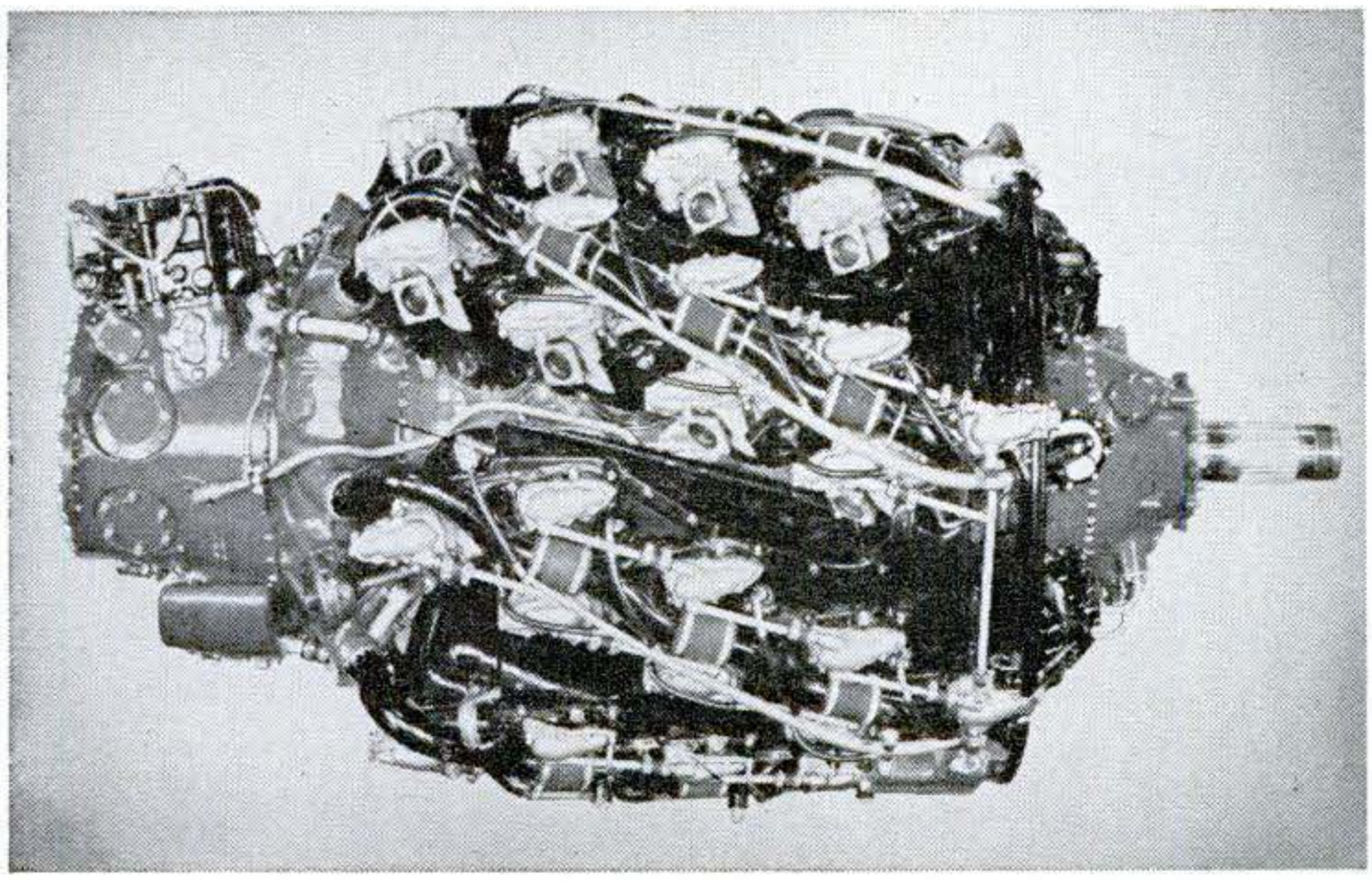
Its six engines are set in the after part of the wing; its propellers push rather than pull.



Streamlined Power Plant

ONLY 33.5 inches in diameter, this 2,500-horsepower, liquid-cooled engine (left) is recognized as the most powerful of its size. Designed and built by Chrysler Corporation's Engineering Division for the AAF, its inverted V design provides better pilot visibility, reduces drag in flight, and helps to conserve fuel. In multi-engine craft, its structure permits practically complete submersion in the wings, greatly reducing drag. Simplified parts make it easy to service the engine.

Wasp Majors to Power Many New Sky Giants



THE Wasp Major, Pratt & Whitney's new 28-cylinder, four-row, radial air-cooled engine that delivers over 3,650 combat horsepower, already has been selected to power many of tomorrow's giant air transports. Among them are the Douglas Globemaster, Boeing Stratocruiser, Martin Mars, Republic Rainbow, and the H-4, Howard Hughes' big flying boat. Two of the Navy's crack, single-engine fighters, the F2G Corsair and the F8B, use Majors.

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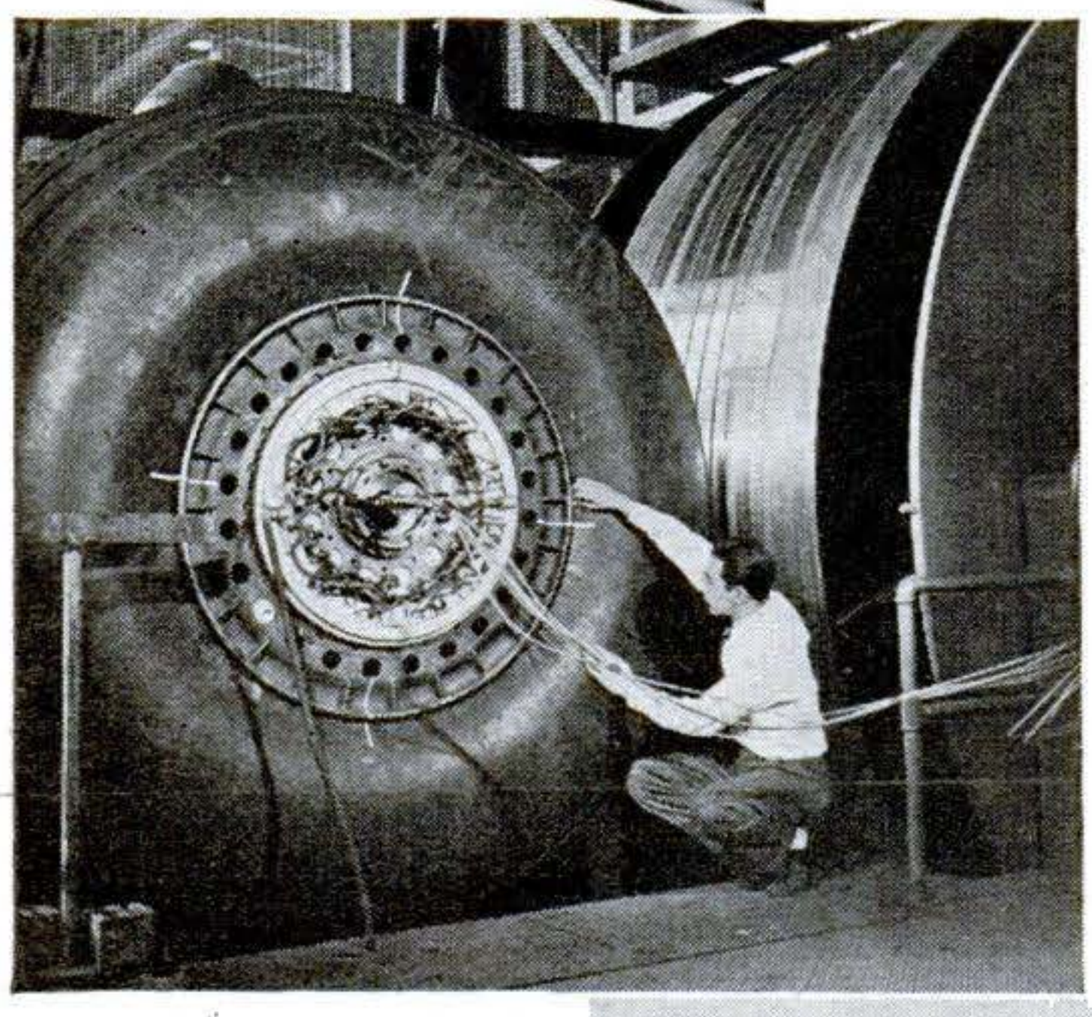
Speaker in Dome

FOR pilot's convenience and safety, the radio loudspeaker is installed in the new Stinson Voyager's dome. Cabin is soundproof.

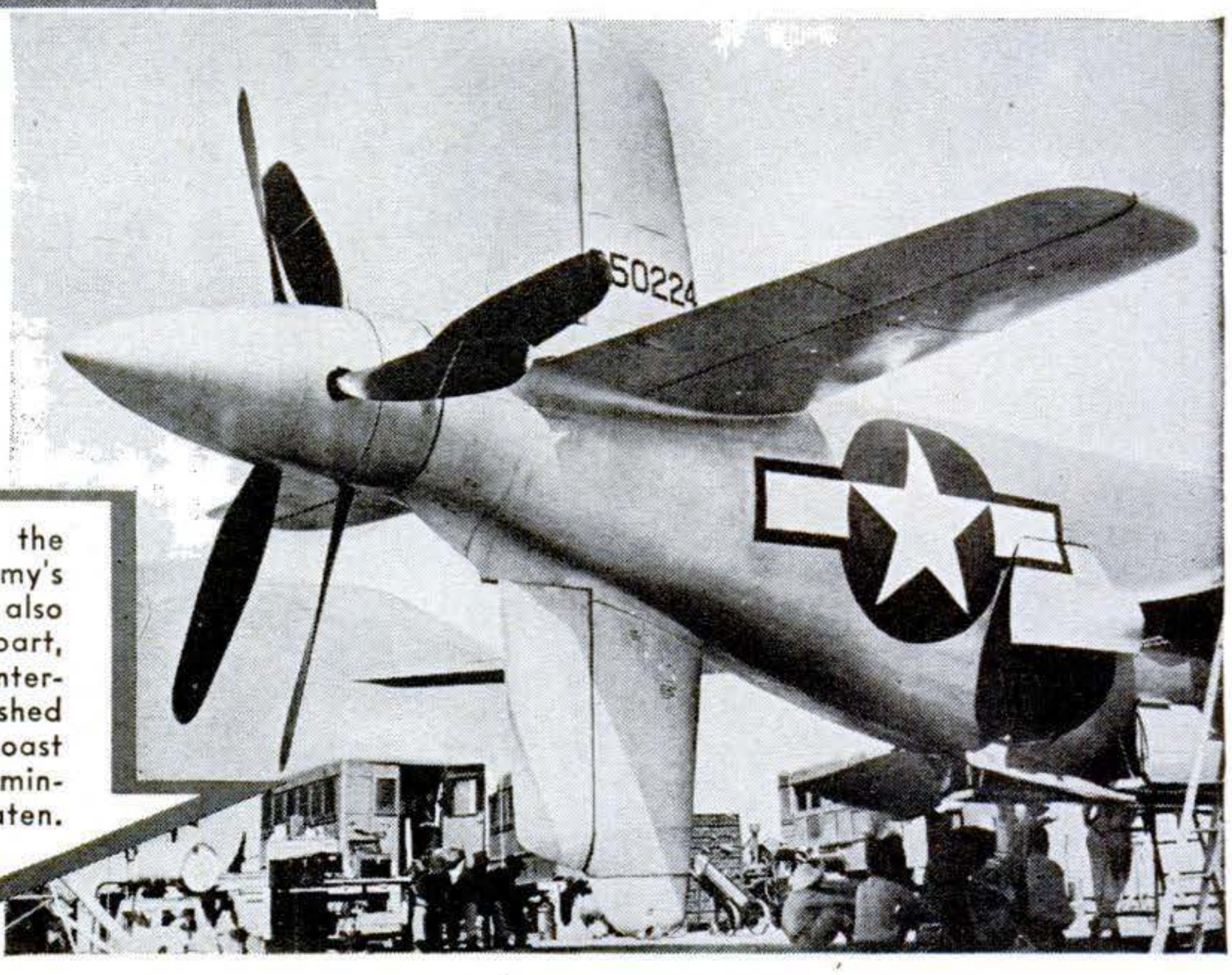
Two Tugs, It's On

A TUG at the leg and chest straps quickly and easily makes the Pioneer 'chute harness fit. At right, pilot loosens leg straps.



Dynamometer Tests Giant Tires

A THREE-QUARTER ton tire of the type used on giant bombers is tested on the world's largest dynamometer, the machine that checks the strength and operating characteristics of new airplane landing-wheel, brake, and tire assemblies. The 110-inch tire is slammed against the 158-ton steel wheel, shown in the photo, as the wheel speeds around at two miles a minute, simulating actual landing conditions without risking personnel or equipment.



Here is the tail of the prototype of the Army's XB-42 Mixmaster and also its commercial counterpart, the DC-8. The twin counter-rotating propellers pushed the ship nonstop from coast to coast in 5 hours 17 minutes, a record later beaten.

DOUGLAS DC-8 TRANSPORT

Your Pin Up—

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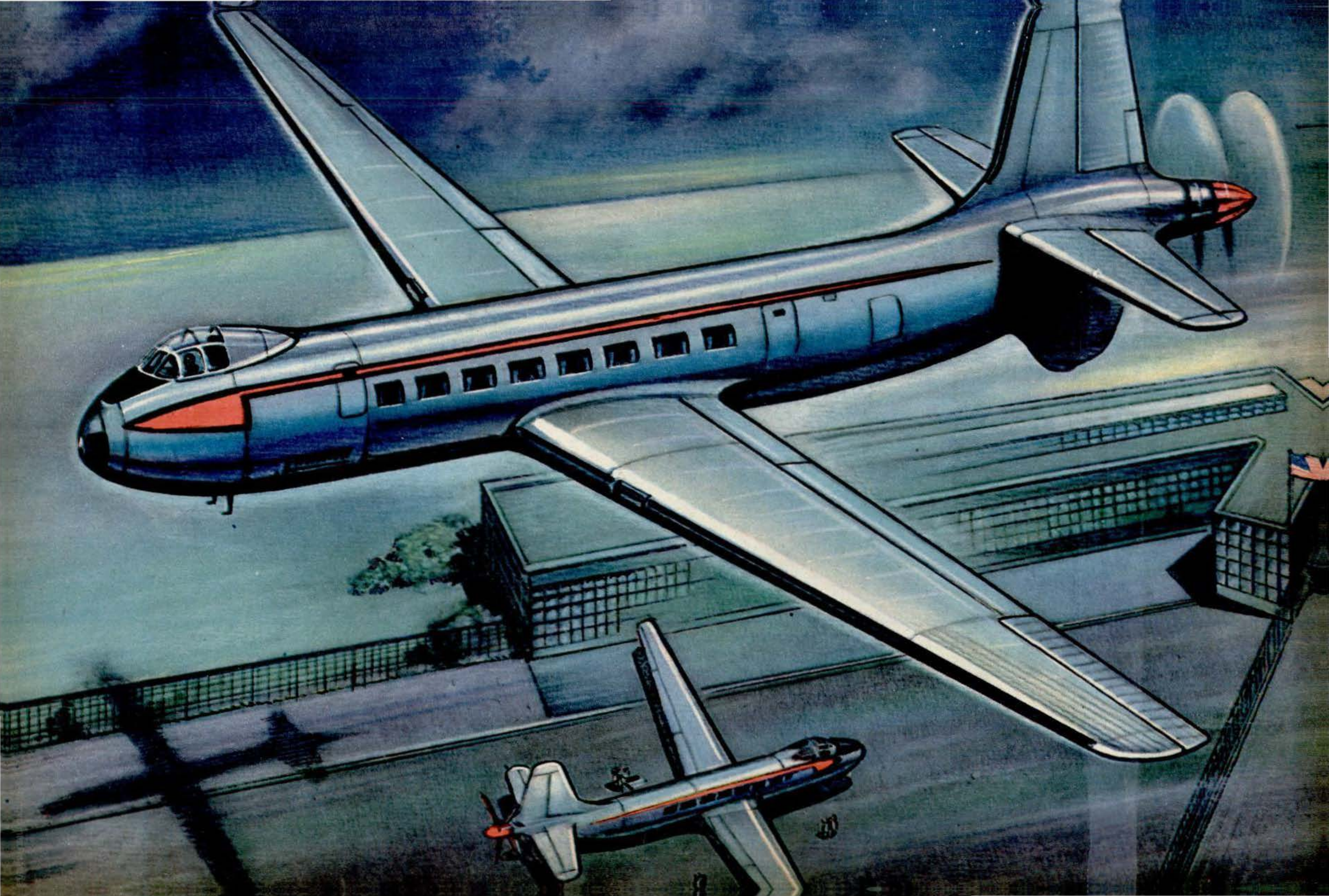


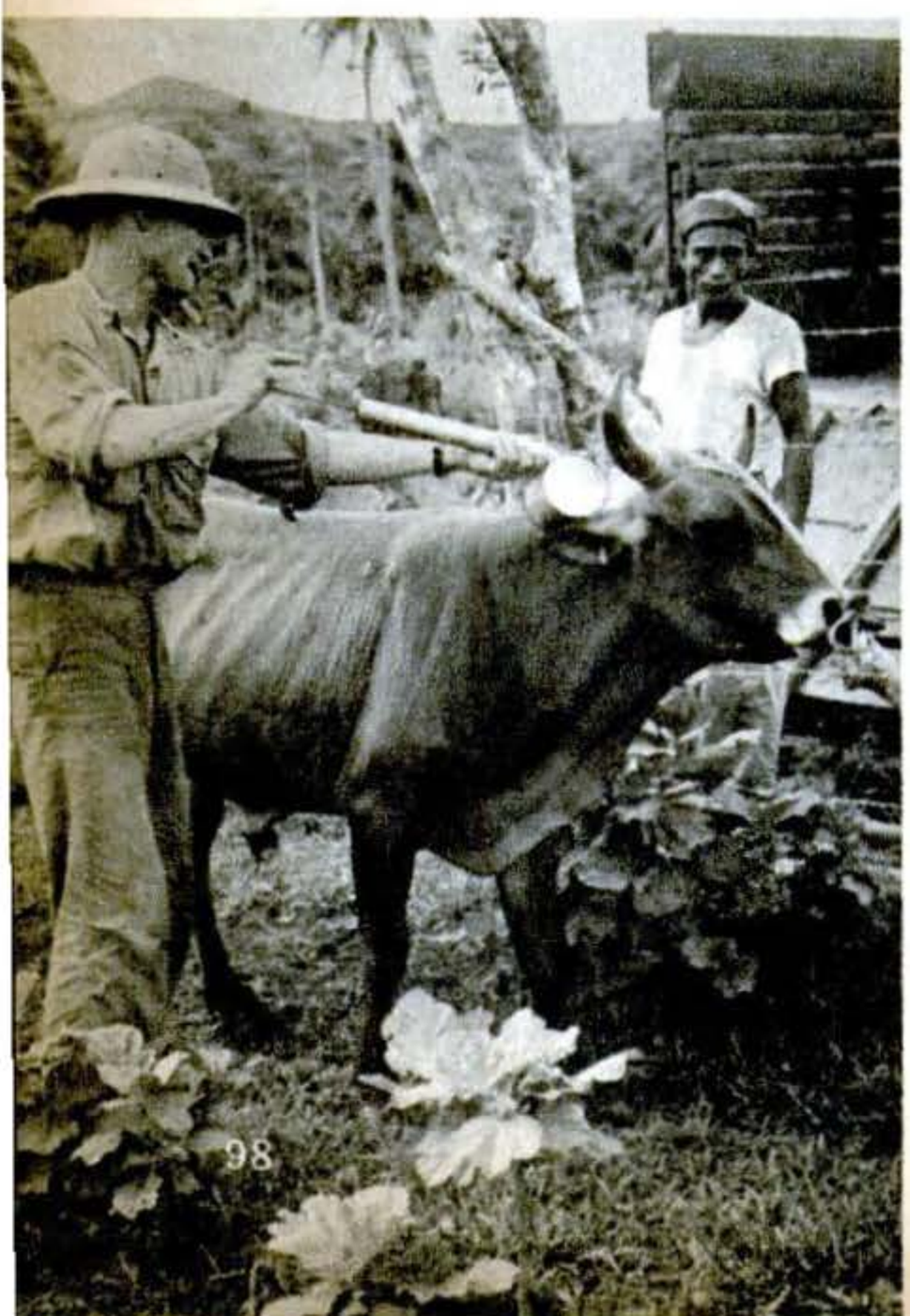
ROUNDUP ON GUAM

NOT long after United States Marines had completed a "rabbit hunt" for Jap troops hiding out in the hills of Guam, representatives of the American Military Government aided the native Chamorros in staging a roundup of their cattle, which the natives had turned loose in the jungle rather than allow the Japs to seize the animals when the island was invaded. AMG members and Guamians used trucks, jeeps, and hunting dogs in tracking down the beef-on-the-hoof on the 32-mile-long island. When cattle were brought in they were herded into pens, deloused with DDT, and held until reclaimed by their owners.

Guam was bombarded by Jap warships on Dec. 8, 1941, and two days later the island was taken—the first bit of U. S. territory lost in the war. This two-day "warning," however, gave the Chamorros sufficient time to drive their animals into the thickly wooded interior.

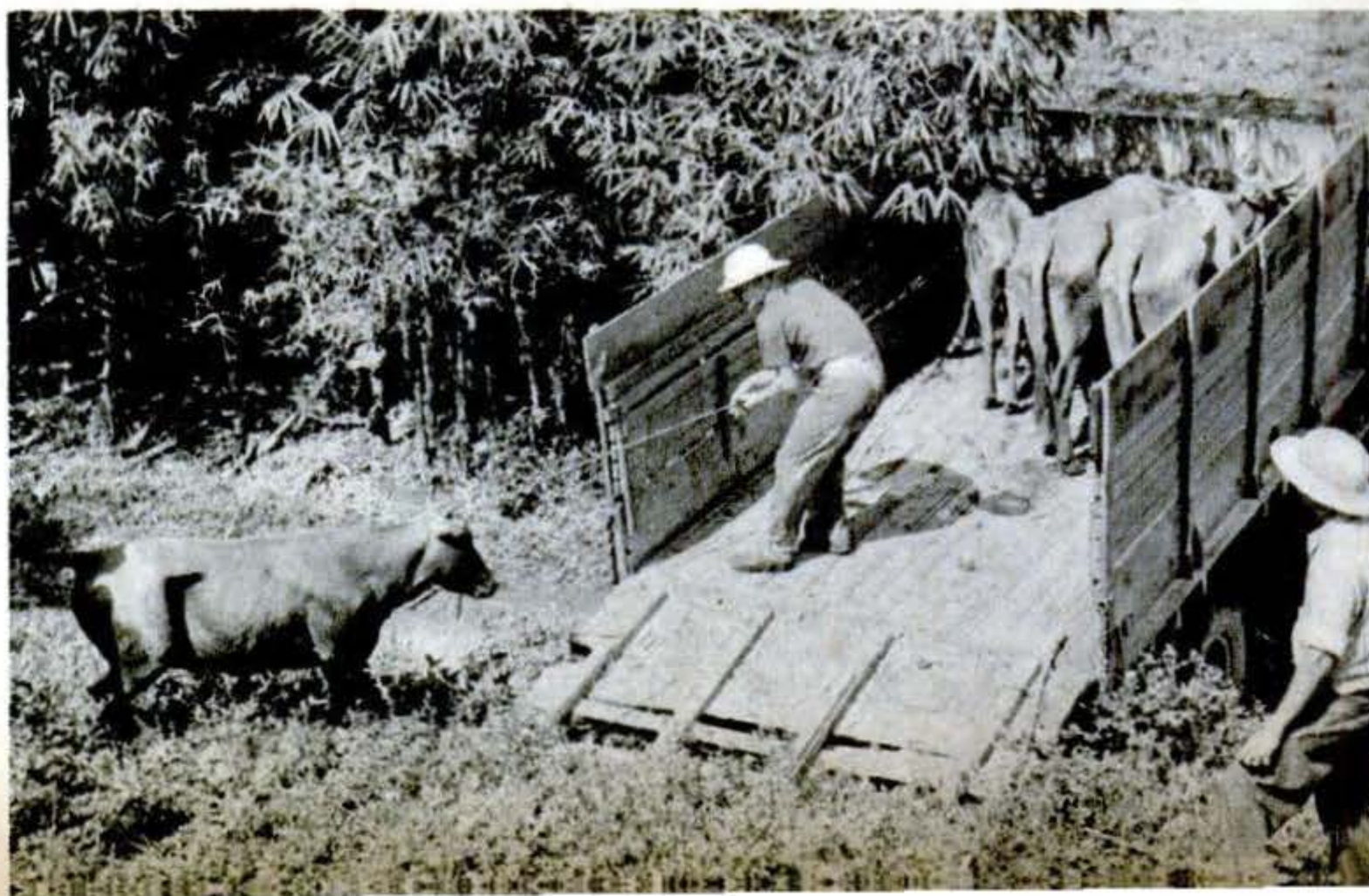
Now the hunt is on to recover the cattle after their more than four years of freedom.

An American Military Government man on Guam turns cowboy as he lays a lasso on a cornered steer. After U. S. Marines had cleared the last Japs off the island, AMG representatives lent a helping hand to the native Chamorros in rounding up the cattle Guamians had turned loose in the jungle to keep them out of Japanese hands.



Recaptured after more than four years of freedom in the interior, a steer gets a DDT bath (left) from Lt. Charles Westbrook, USMCR, of Bastrop, La., before being herded into a pen for identification.

Trucks, jeeps, and hunting dogs were used to track down and collect the animals. Their balkiness added to the Wild West flavor.

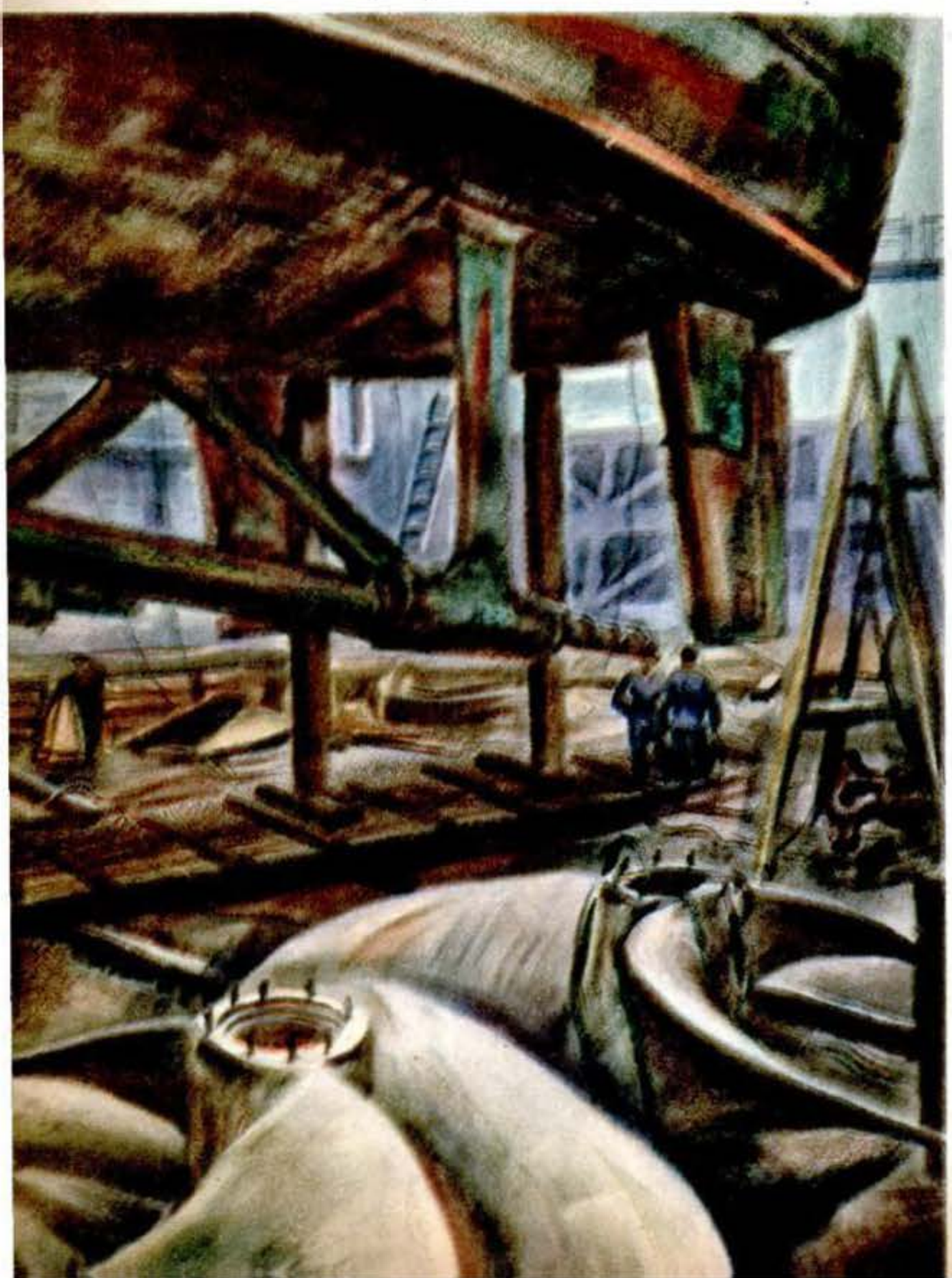


With a wild leap, one of the herd races into an AMG-built enclosure where it will be claimed by its owner.

A roundup day over, Guamians and Americans sit on a corral fence, Western style, looking over the day's haul.

Radar plot room, escort carrier's nerve center, where contact is maintained with surface craft and planes.

Artist Jamieson catches a view of the stern of a 2,000-ton destroyer laid up in dry dock off Okinawa. The stricken ship's propeller lies in the foreground.



WHAT ONE ARTIST SAW OF THE WAR

THE gifted pen and brush of Lt. Mitchell Jamieson, USNR, have recorded war scenes with a poignancy hardly matched by the millions of words that have been written. Dashing with invasion troops onto Sicily's shores and the bloody Normandy beaches, traveling in convoys, and landing with Marines on Okinawa, Jamieson has caught the drama of men and machines at the business of war.

Lt. Mitchell Jamieson

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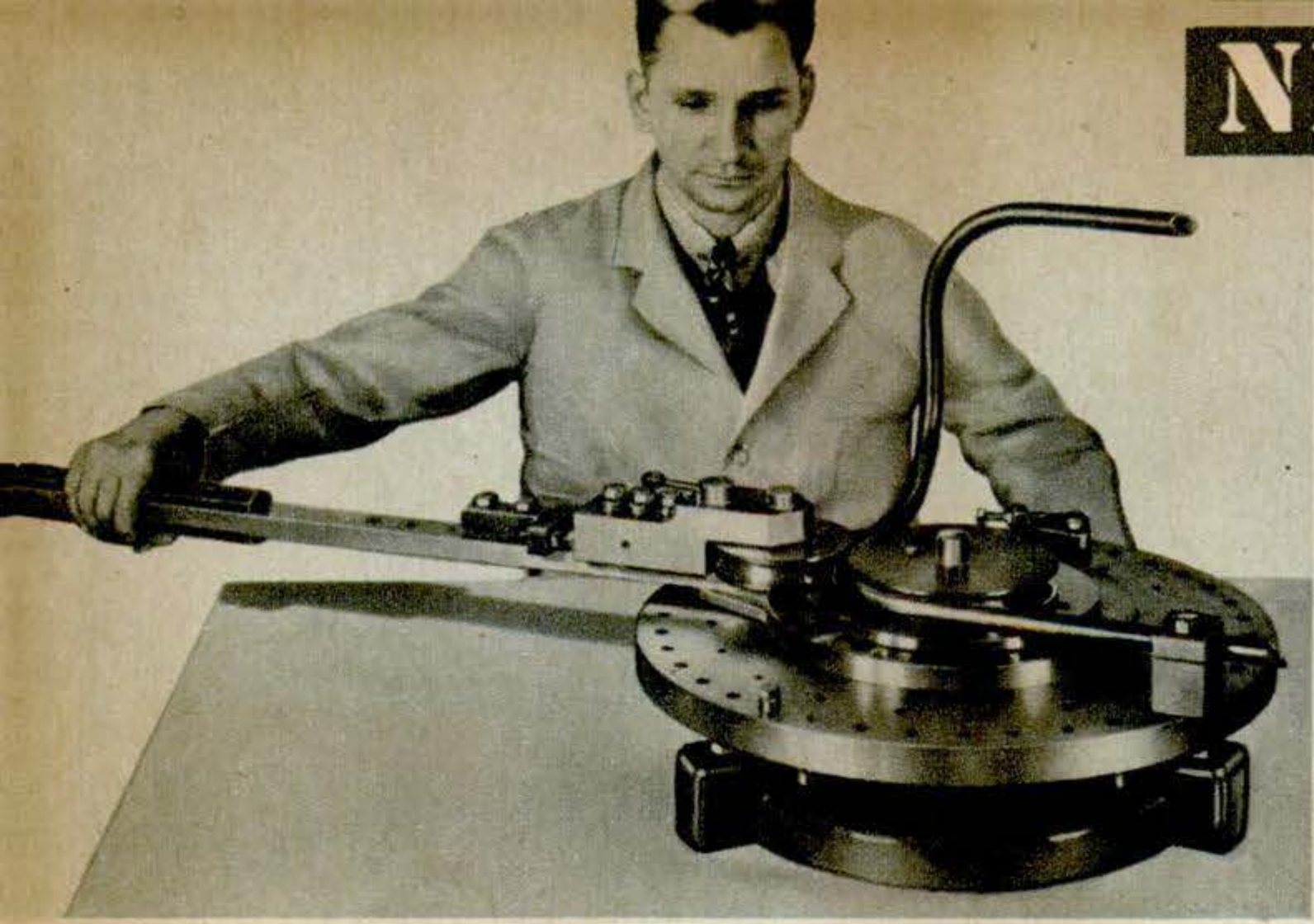
A B-29 comes in at Iwo with one engine dead, as ambulances and personnel stand by in case of a crash.

Its bow sheared almost off and its innards exposed, a Jap destroyer clutters the beach at Iwo. The corpselike emptiness of this rusted hulk emphasizes the artist's skill in portraying the crushing Jap defeat.

NEW TOOLS

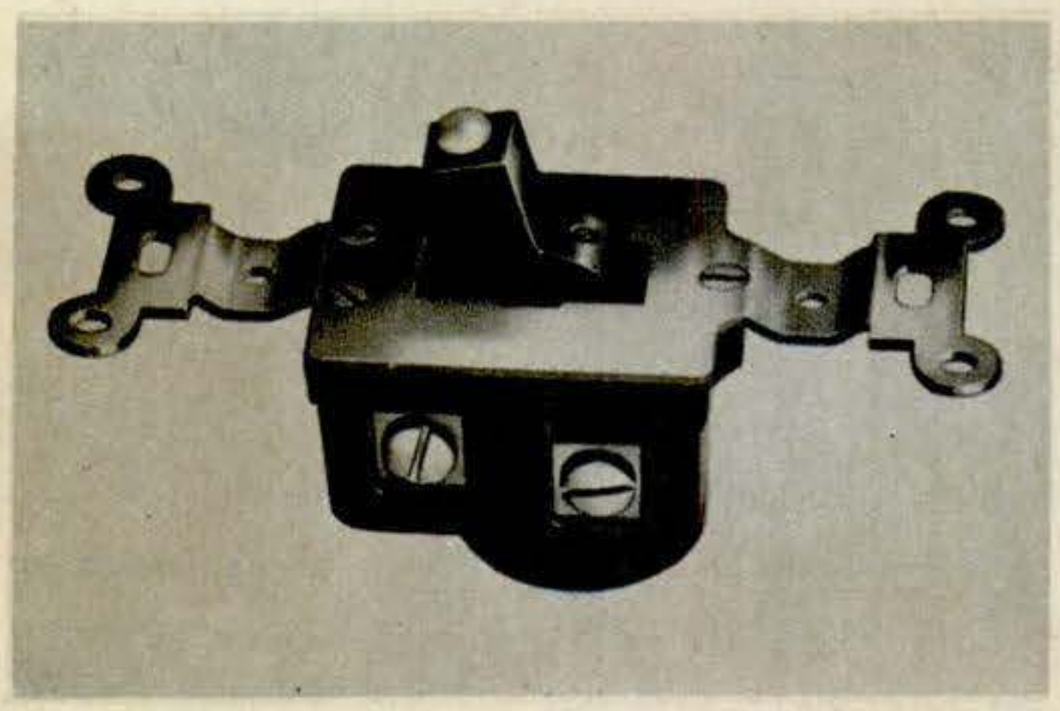


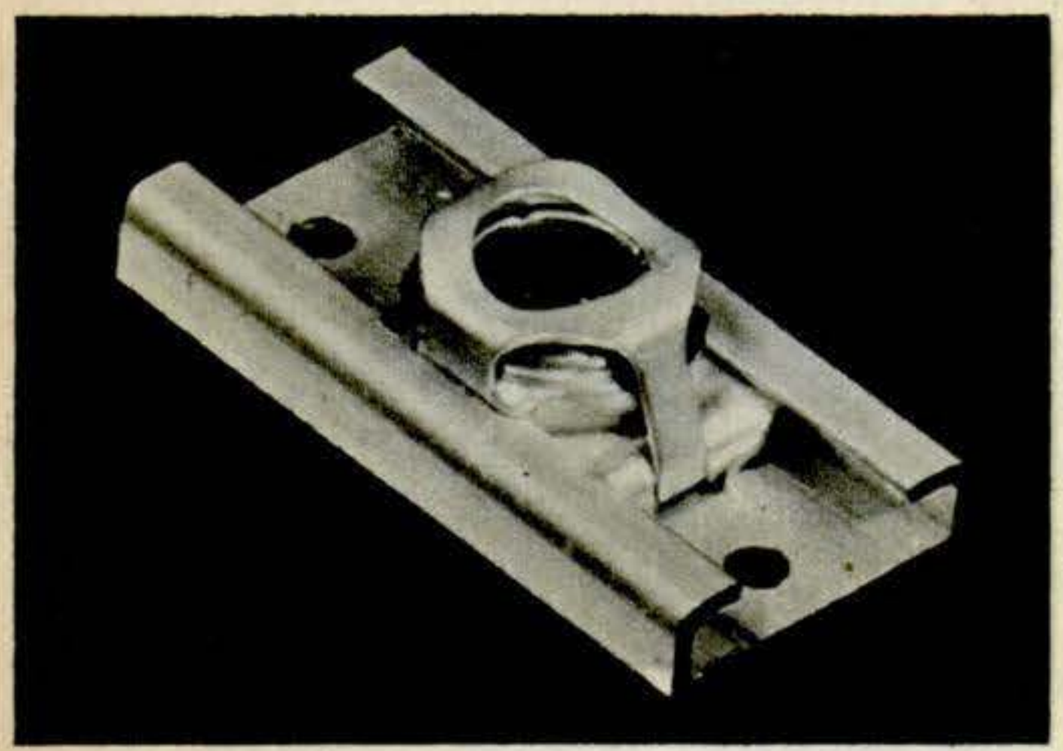
Die-less Duplicating Saves Time and Money

A COMPACT and portable precision unit, the Di-Acro Bender is designed to form and duplicate an unlimited variety of parts and pieces—eliminating, in many cases, the need for special dies. Benders can be set up on the job to shape all ductile materials, including round, half-round, square, and hexagonal rods; tubing, angle channel, and moulding stock.

Standard Nuts Fit New Floating Anchor Unit

STANDARD nuts may be the replacements in the new Click floating anchor nut, shown below. The unit consists of the base, retainer, standard nut, and steel-spring clip, all assembled. The clip, which holds the nut, can be disengaged easily by prying it up with an ordinary screwdriver, permitting quick removal of the damaged nut.



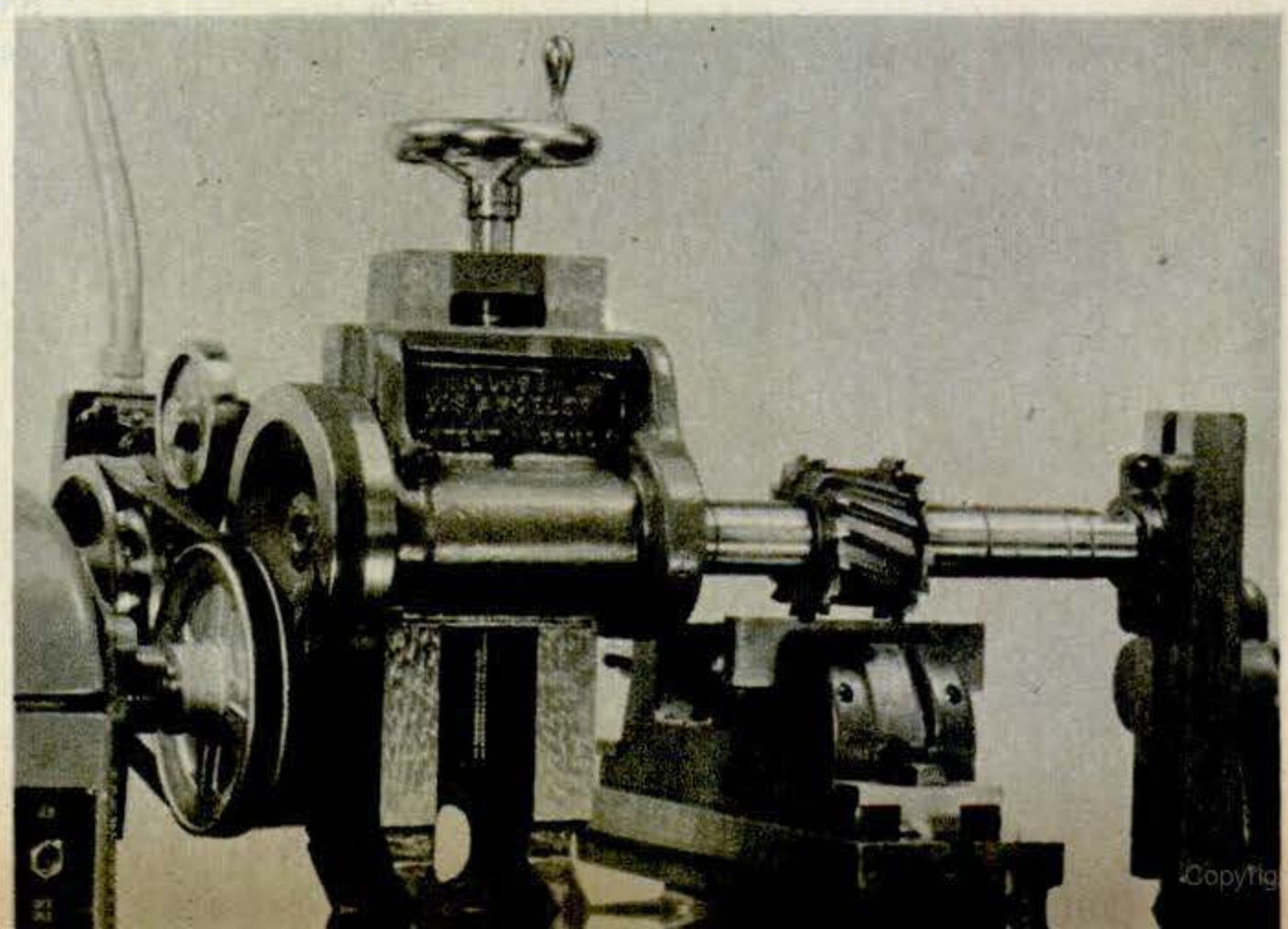


Toggle-Lever Switch Delays "Shut-Off" of Electricity

YOU can switch off your bedroom light and be under the blankets before the light goes out, if your wall switch is a Tymzit. Operated like the standard toggle-lever switch, it offers both delayed-action and instantaneous "off," plus a time-selector that can be set at any interval from zero to three minutes. The T. J. Mudon Company, of Chicago, is the manufacturer.

Portable Miller Can Be Quickly Attached to Lathe

THE miller shown at the right can convert a lathe in less than three minutes into a combination machine that does the same precision work as a costly milling machine. Made by the Globe Products Manufacturing Co., of Los Angeles, it fits the ways of the lathe, and its spindle is moved into position to engage the work.



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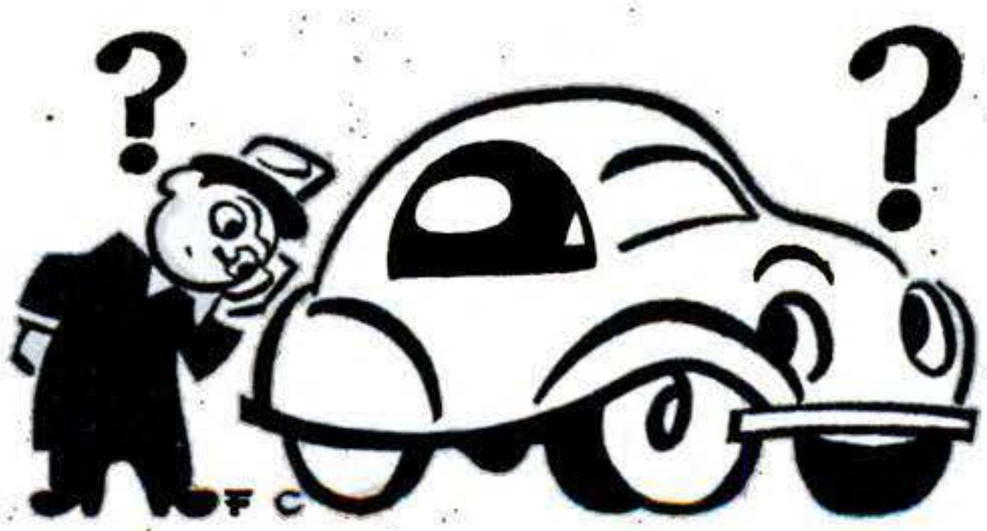
I'D LIKE TO SEE THEM MAKE...

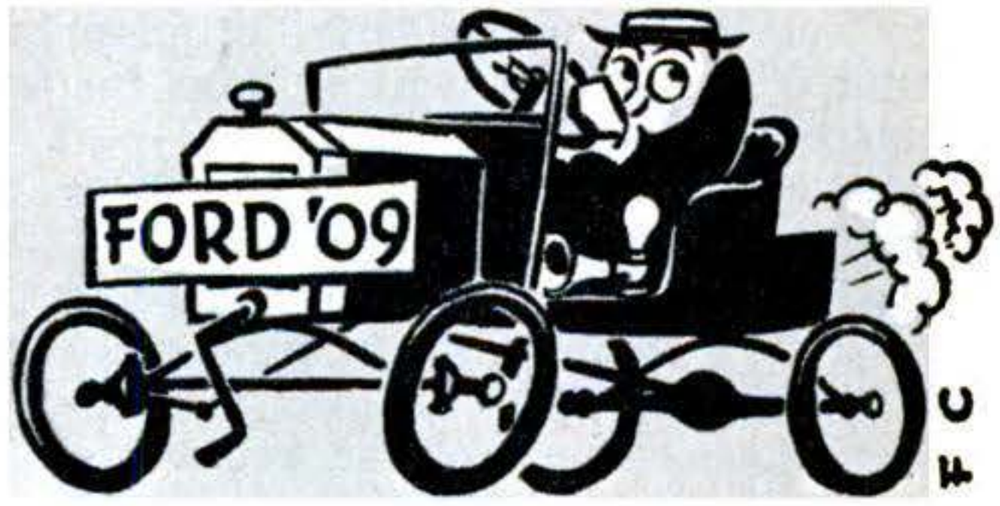
Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science Monthly will pay five dollars for every such suggestion published.

THERE'D BE FEWER FIGHTS at baseball games if an automatic umpire, controlled by photoelectric cells, were used. These cells could be adjusted to the height of the man at bat and could be made to record all plays. It's the idea of Jack Greenfield, a Brooklyn, N. Y., fan.

A GLASS AUTOMOBILE MUFFLER Made of shock- and temperature-proof glass, it ought to last the life of the car. Or, maybe, suggests A. D. McFadyen, Richmond, Va., one of the new plastics might be used.



SNOWBALL-PROOF GLOVES. Something should be done by the inventors, says Billy Olesky, of Bayonne, N. J., for those who gird their loins and go into battle with snowballs. You can't use your bare hands very well, and available gloves don't do much good for long; they get wet and soggy. Even if you win the fight, you are likely to get a case of chilblains or, at the very least, chapped hands. Some type of warm, dry gloves for snowballers is badly needed.



DATED AUTOMOBILES. They date coffee; why not gas wagons? If motor-car manufacturers would include on each name plate the year in which the car was built, there would be fewer people gypped by speedometer readings. The idea for this came from Benjamin Tassmer, Jr., Wallingford, Conn.

RECORDER FOR THE VOICE of the visitor who calls when you are out. If there is no answer, he speaks into a microphone, making a wire voice recording. William E. Howard, Wichita, Kans., suggested it.

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DEVELOPING COLOR

PROCESSING IN YOUR OWN DARKROOM GIVES YOU THE FUN

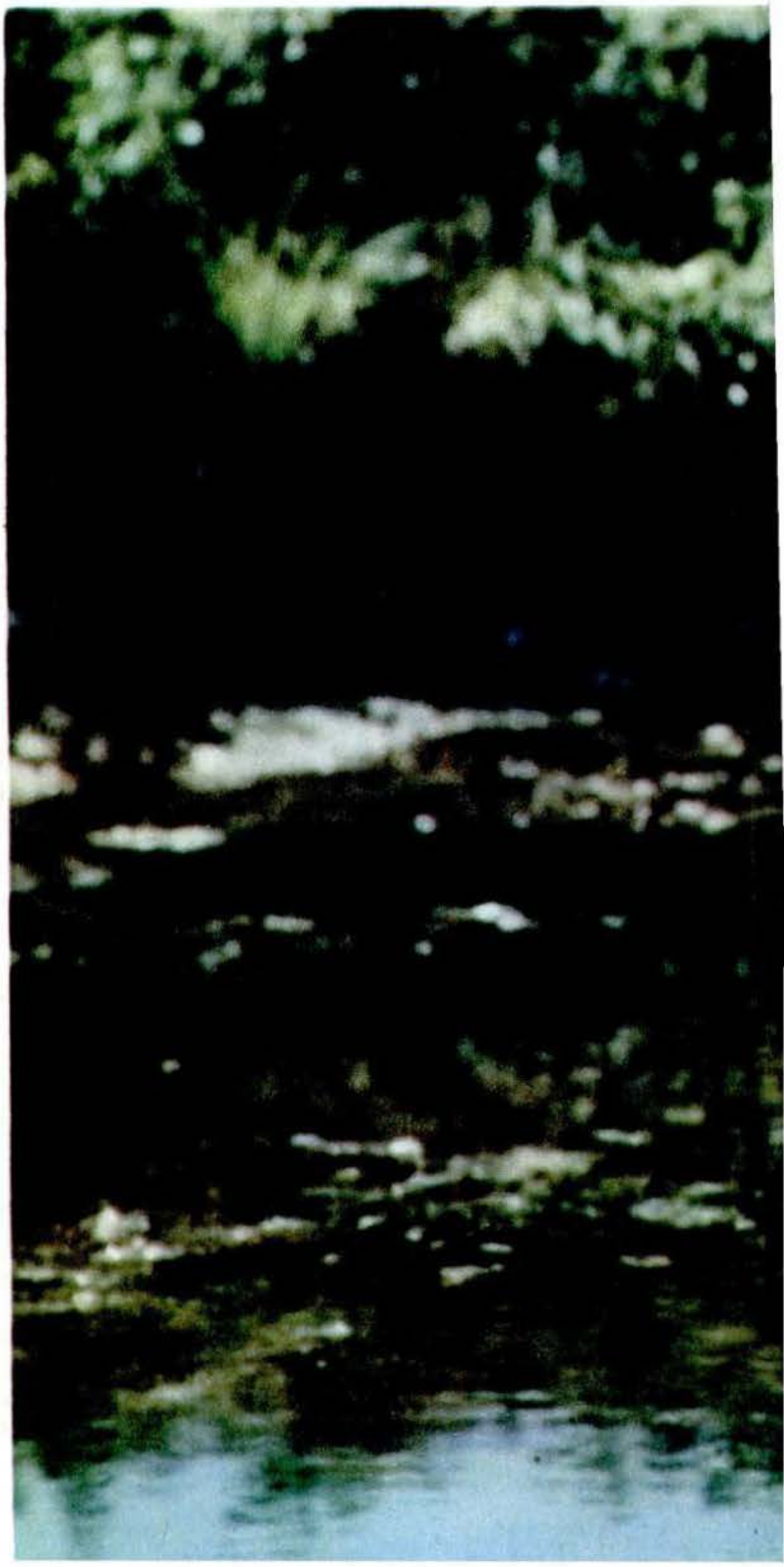
ANYONE who can develop black-and-white negatives can develop color film. The process takes longer, and there are several more steps required, but home developing has a satisfaction for many amateur photographers who like to see the image forming in the tray within a few hours of snapping the shutter, instead of waiting days for the processed transparency.

Of the color film now available to the general public, Ansco was the first widely distributed on a develop-it-yourself basis. It is, in principle, a combination of three separate films arranged in layers. Each is sensitive to one of the three colored regions most prominent in the spectrum, and to the light of that color. Through the combination of the three color sensitivities, it is possible for the entire range of hues to be recorded.

Home developing can prove a distinct advantage to the wide-awake color photographer. Exposure is somewhat more critical for color film than for black-and-white negatives, errors in exposure affecting not only the over-all density of the transparency but the color rendition as well. If you develop your own color film, exposure errors (when known) can be compensated for to some extent by varying the time the film is in the first developer. While it is not generally recommended except in cases where it would otherwise be impossible to get any picture at all, compensation for underexposures of as much as one lens stop can be made by prolonging the first development to 17 minutes.

Ansco color film is supplied in two different emulsions—a daylight type for taking pictures outdoors in sunlight and a tungsten type for indoor photography with artificial illumination. Tungsten-type Ansco color film is designed for exposure under 3,200-deg. Kelvin lamps, and transparencies made with it tend to be slightly cold or bluish in tone when photofloods are used. A UV-15 filter over the camera lens helps to overcome this and produces transparencies of proper color balance. The even colder results of a photoflash lamp can be corrected by a UV-16 filter, which also may be needed with daylight-type film for color pictures of subjects in the shade or for scenes exposed on or over water. Neither requires any increase in exposure.

When it is necessary to use tungsten-type film outdoors in sunlight, a No. 11 conversion filter is needed. This requires an increase in



FILM AT HOME

By KENNETH S. JOHNSON

OF SEEING YOUR TRANSPARENCIES BLOSSOM TO FULL LIFE

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exposure equal to half a lens stop more than would be needed for exposing daylight-type film under the same conditions. Similarly daylight-type film may be exposed under 3,200-deg. Kelvin lamps with a No. 10 conversion filter over the lens. Here the necessary increase in exposure is two full stops more than for tungsten-type film.

No special skill or equipment is needed for processing Ansco color film. Sheet film may be handled in glass, bakelite, hard-rubber, or enameled trays or tanks. Roll film requires no more than the simple bakelite or stainless-steel daylight tank used for developing black-and-white negatives. Of course, scrupulous cleanliness is necessary, and careful attention must be given to such matters as the correct temperature and the time the film is treated in each solution. All the necessary chemicals may be purchased in one chemical outfit. They are dissolved in plain water and are ready for use when brought to the proper temperature.

Seven processing solutions and four washings in clear water are required. The completed full-color transparency is then ready to hang up for drying about an hour and a half after it has been put into the first developer—about an hour longer than the time required to develop the average black-and-white negative in most home darkrooms

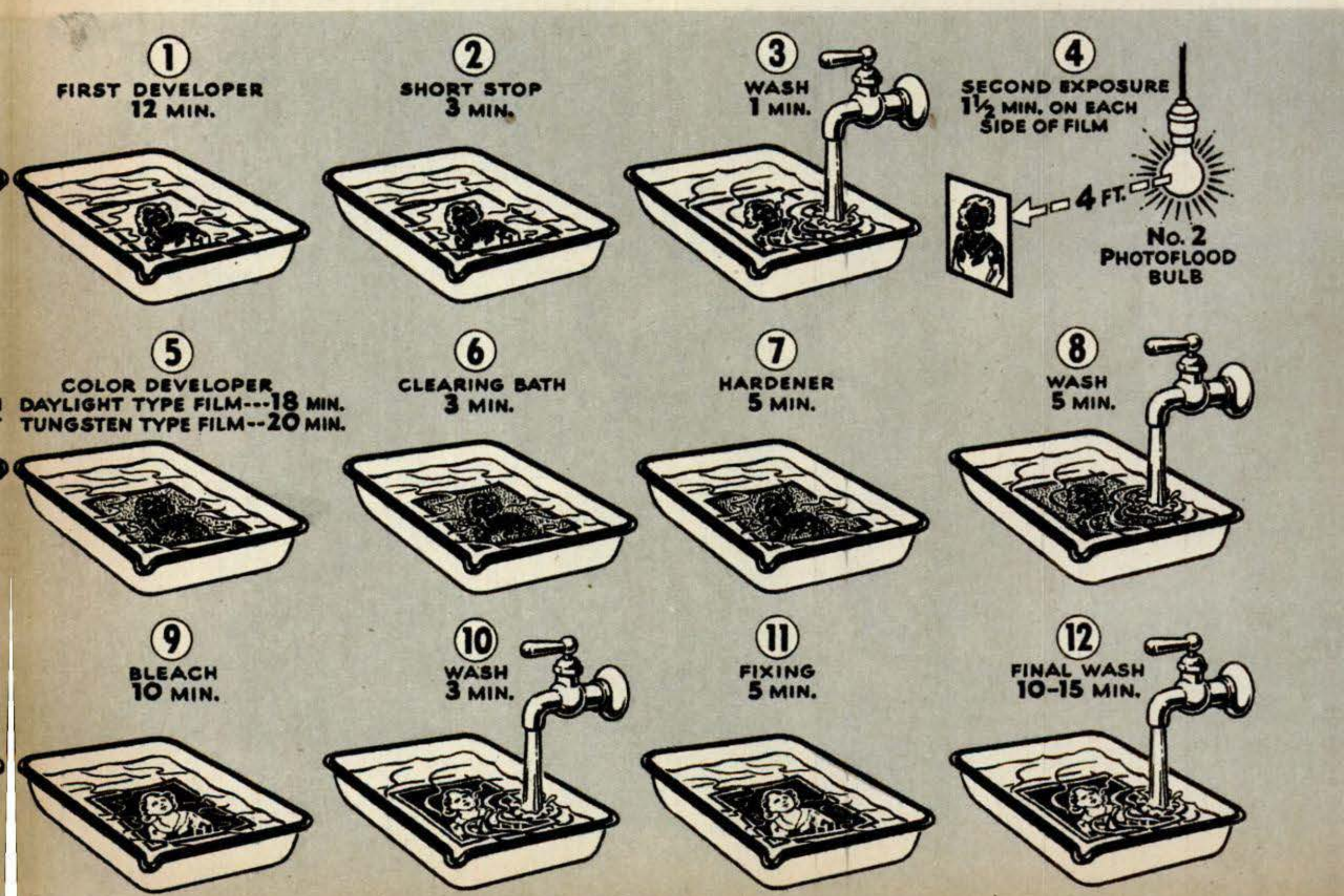
Temperature is critical for the first developer and for the color developer. It must be maintained at 68 deg. F. All other solutions and the wash water may be between 60 and 70 deg. F. The first two steps of the 12 involved are carried out in darkness; the others may be conducted under normal home lighting.

To provide adequate temperature control, the seven trays containing the processing baths can be placed in one or two large trays containing water of the proper temperature. If more than one sheet of film is developed at one time, care should be taken to avoid mechanical damage to the emulsions. Proper agitation is important in obtaining even development. Tilt the tray from side to side and from front to back. Ansco color film should receive constant agitation for the first five minutes in both the first developer and the color developer and a few seconds agitation each 15 seconds after that.

Here are the 12 steps, the time required for each, and an explanation of what each does in developing the transparency. It may be helpful to refer to their graphic presentation below as you read.

1. *First developer.* Time required: 12

From film to transparency, the color process requires seven chemical baths, four washes, and an exposure to bright light that makes developable those parts of the emulsion not exposed originally in the camera.



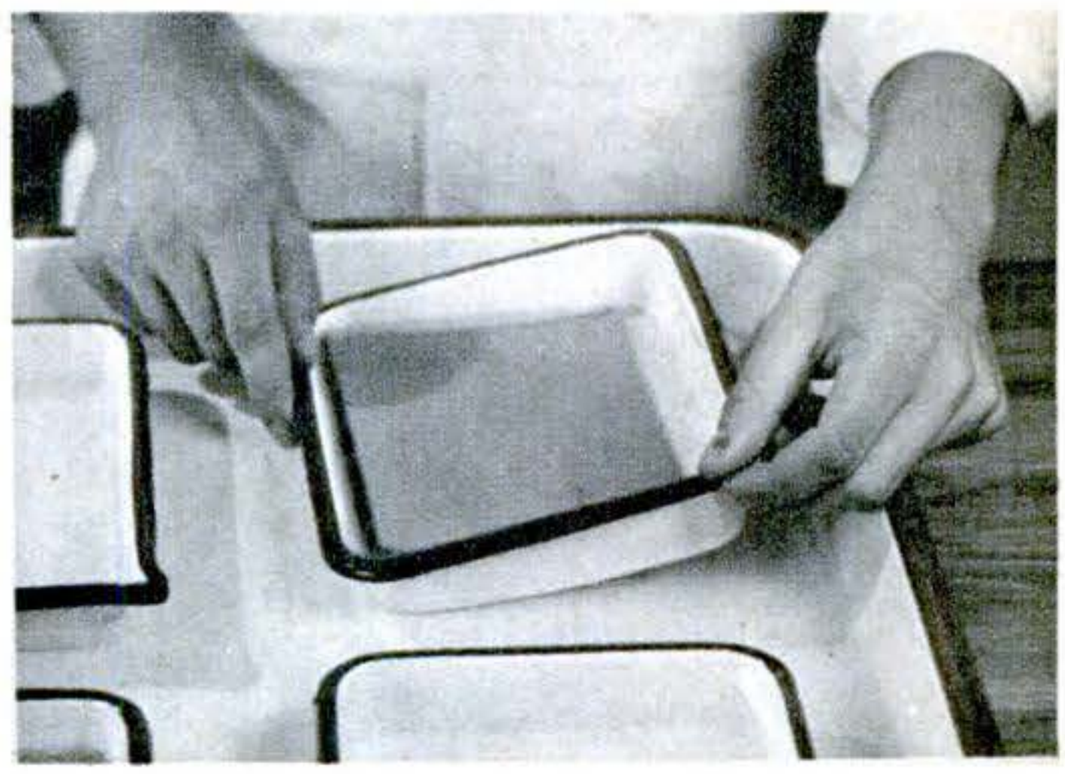
One method of maintaining even temperature is to place the seven trays of chemicals in one or two large trays containing water at 68 deg. F. Temperature is especially important in the developer solutions.

minutes. This develops the silver halides affected by the camera exposure and forms black-and-white metallic-silver negative images in the three emulsion layers contained in the film.

2. *Short stop.* Time required: three minutes. This neutralizes the first developing solution and halts its action just as in black-and-white film processing. At the completion of this step, room lights may be turned on and left on for the remainder of the processing.

3. *Water rinse.* Time required: one minute. This is, of course, done in running water. It removes the first developer and short-stop solution from the emulsion.

4. *Second exposure.* Time required: three minutes—1½ minutes on each side of the film. In this operation the silver grains not affected by the exposure of the film in the camera are brought, by uniform exposure to bright white light, to a condition in which they can be developed. This step is best conducted by removing the films from their hangers and exposing them, first on one side and then on the other, to the light of a No. 2 photoflood lamp at a distance of 48″. Films may be exposed while still wet from the washing water, but they should be sponged off to remove all clinging drops. They should be handled by their *edges only* to avoid damage to the emulsions. When the second exposure has been completed, the films are replaced in their hangers in preparation for a second development to bring out color.



Proper agitation is important in developing. Tilt the trays from side to side and from end to end. Agitate constantly during the first five minutes.

If roll film is being processed in a daylight tank, the film should be removed from the reel to insure proper second exposure. The film can easily be replaced after the exposure if the rewinding is done with the

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film and reel under water during the process.

5. *Color developer.* Time required: daylight-type film, 18 minutes; tungsten-type film, 20 minutes. During this step the silver halides made developable by the second exposure are converted to images of metallic silver. At the same time, color-forming materials in the film emulsions undergo a chemical change to create dye images.

6. *Clearing bath.* Time required: three minutes. This solution neutralizes the color developer remaining in the film and also prevents undue swelling of the wet and fragile emulsions.

7. *Hardening bath.* Time required: five minutes. This hardens the gelatin of the film and protects the emulsions against softening during later steps in the processing.

8. *Wash.* Time required: five minutes. This washing removes all traces of color developer and clearing-bath and hardener solutions from the film emulsions.

9. *Bleach bath.* Time required: 10 minutes. This converts the silver images formed during the first development and color development to chemical compounds (silver bromides) soluble in the fixing bath.

10. *Wash.* Time required: three minutes.

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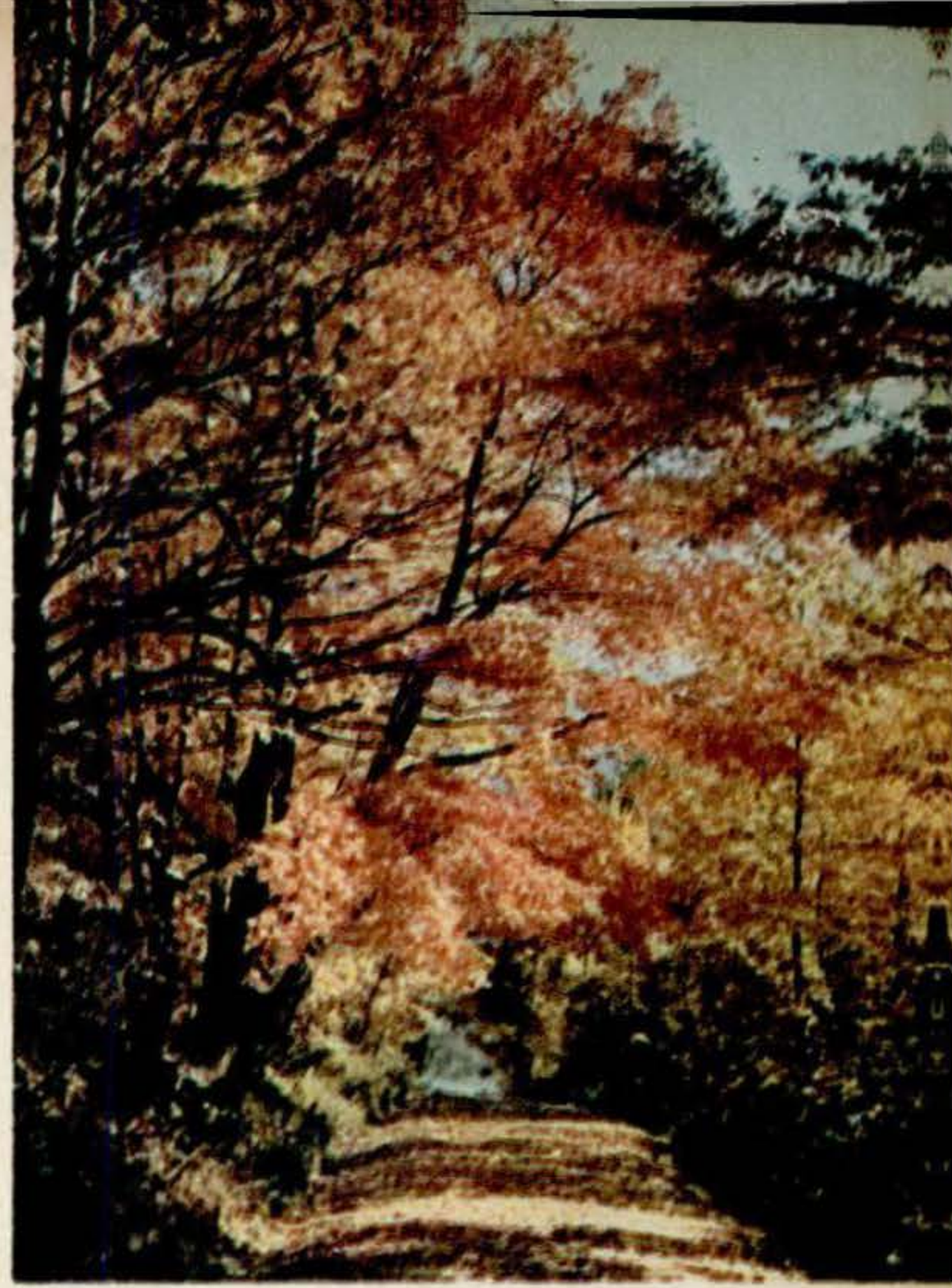
This removes the bleach-bath solution from the film emulsions.

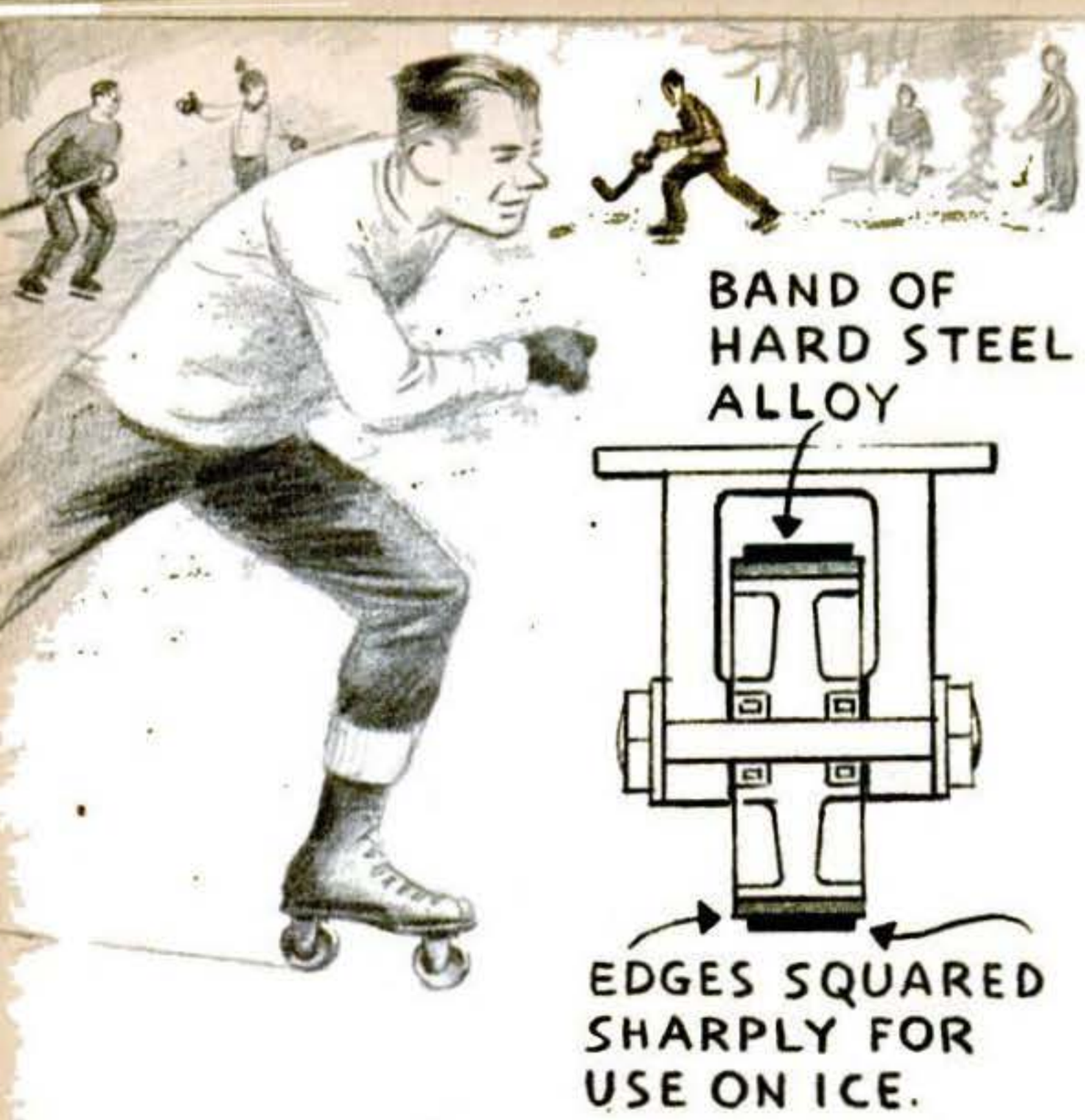
11. Fixing bath. Time required: five minutes. This dissolves the negative and positive silver-bromide images and leaves the finished dye images. At the completion of this step, the finished transparency, which consists of these dye images, can be seen for the first time.

12. Washing. Time required: 10 to 15 minutes. This removes the fixer from the film. The transparency is then wiped free of excess surface moisture and hung up to dry. After this it is ready for viewing.

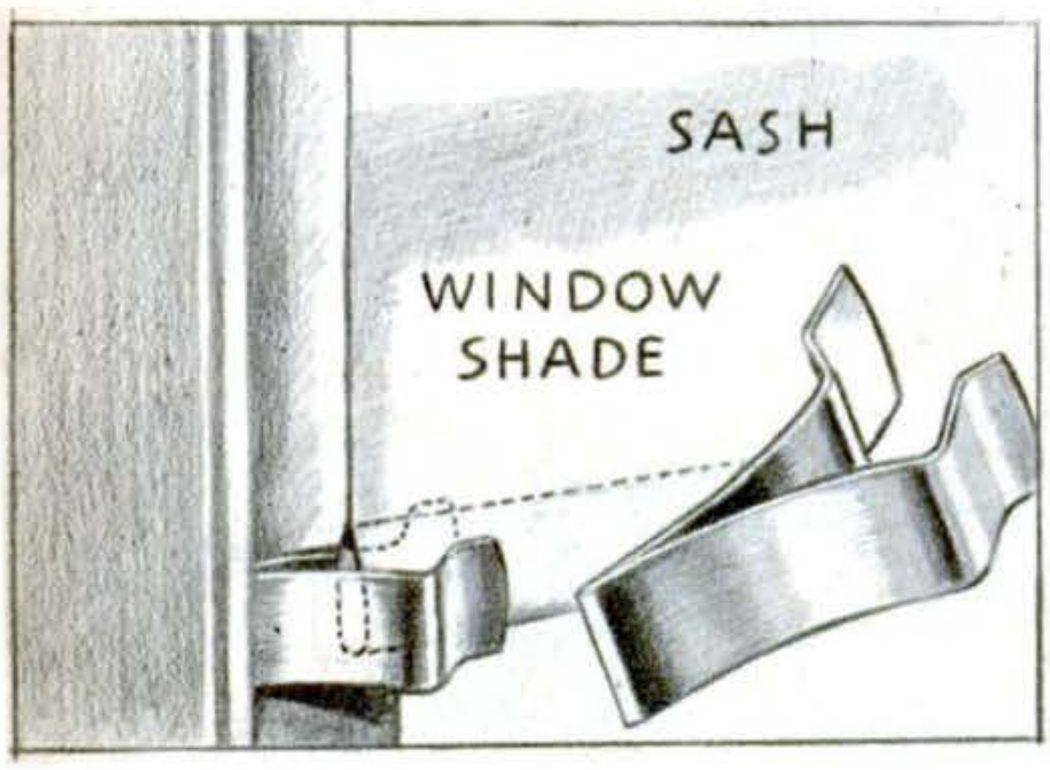
The entire processing procedure need not be completed at one time. If you wish, the film may be carried through the first two steps (first developer and short stop), washed in cold water for 10 minutes (not the one minute called for if processing is to be continuous), and then hung up to dry. After drying, the film may be stored for any convenient length of time before carrying out the remainder of the processing, which would, of course, begin with second exposure. Film partially processed in this manner should be protected against mechanical damage and strong light during storage.



NEW IDEAS FROM

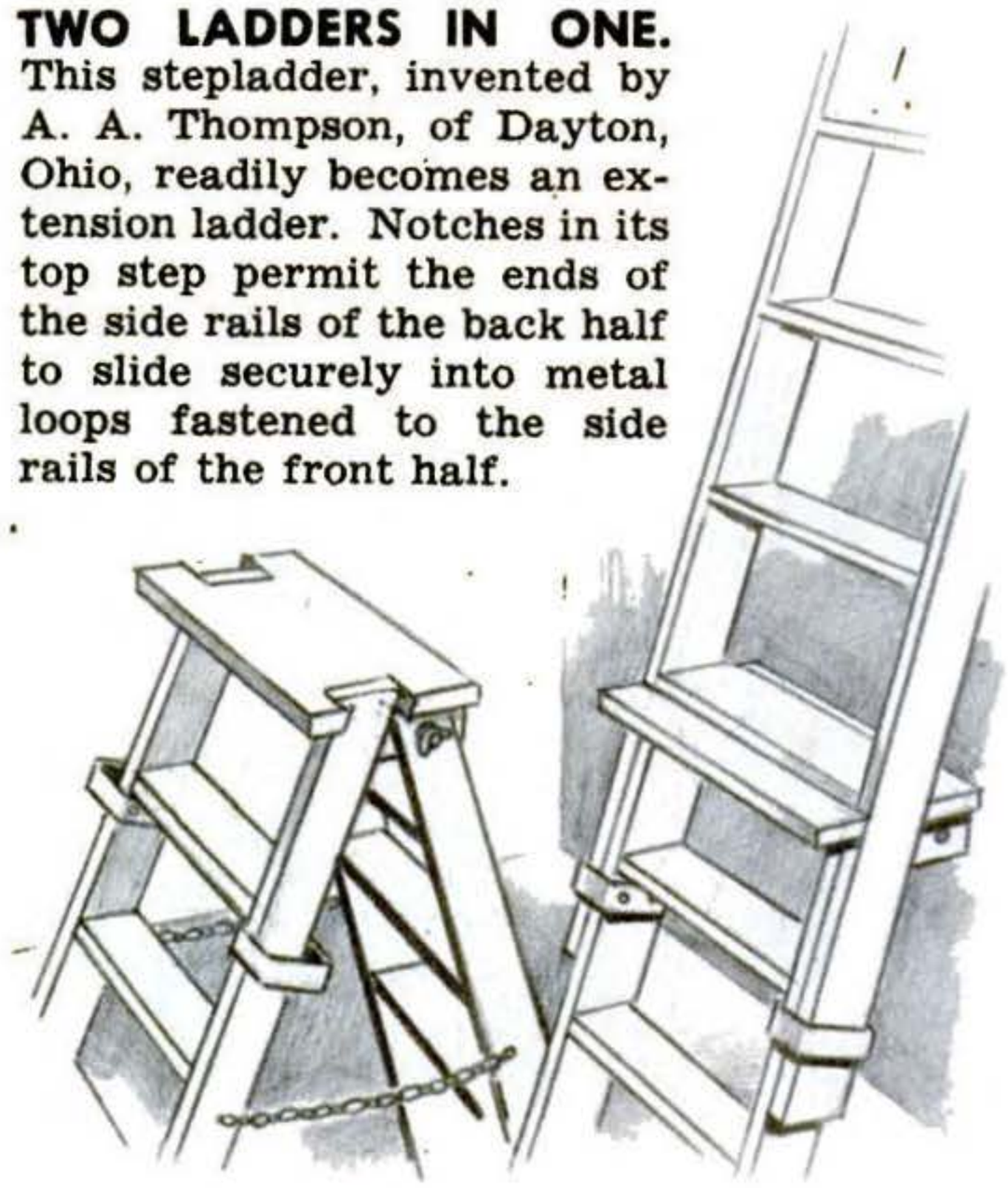


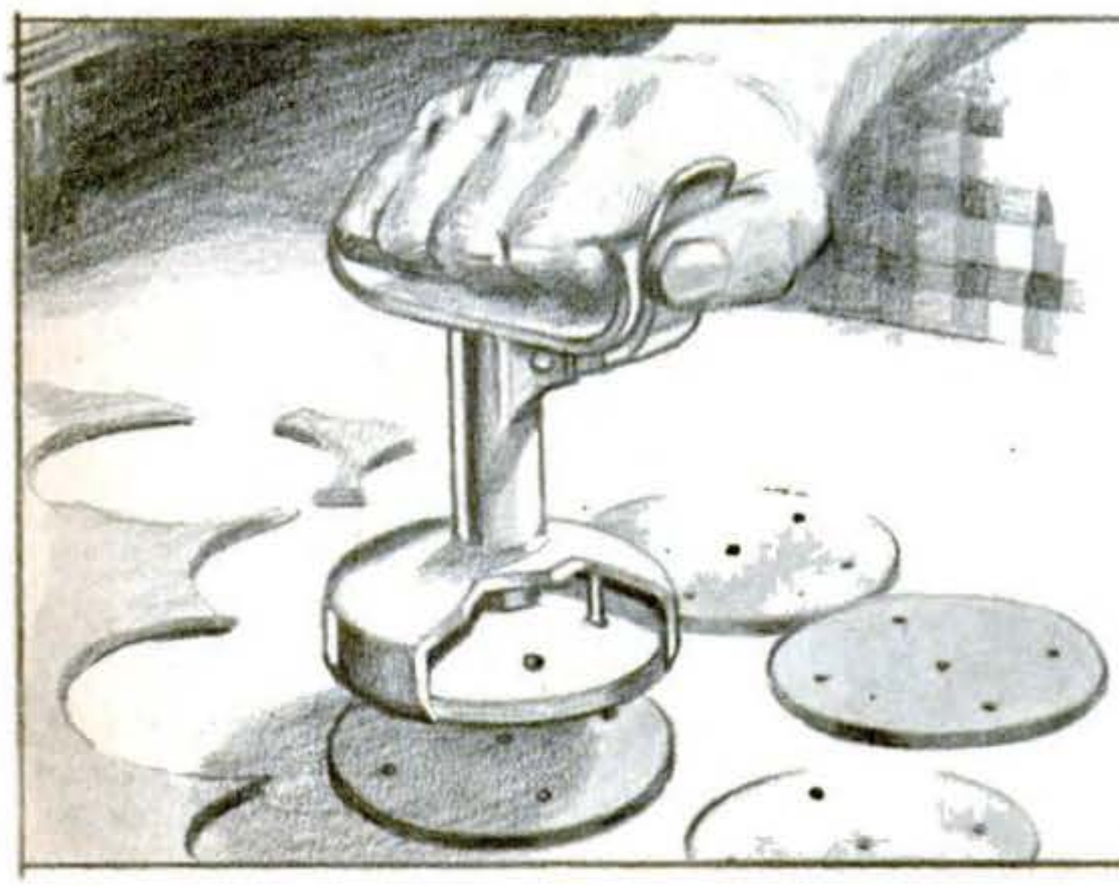
ALL-SEASON SKATES are an invention of Reuben E. Paystrup, of Levan, Utah. The person who wears these unconventional roller skates can play in a game of ice hockey as readily as he can roll along cement sidewalks. Each skate has a single front and rear wheel, instead of the usual two. The wheel rims are fitted with two bands of hard steel alloy or a similar substance; the inner band is exactly the width of the rim, the outer band is narrower. The edges of these bands are squared sharply, so that they will dig in and prevent the wheels from slipping when the roller skates are being used on ice.



WINDOWS STOP RATTLING when the thin point of the gadget above, created by E. C. Lyons, of Brooklyn, N. Y., is slipped between frame and sash. It's made of a piece of springy metal, bent double. The ends are pinched together when the point is inserted; when released, they make the device an effective wedge. At the same time, it can hold a window shade in place.

TWO LADDERS IN ONE. This stepladder, invented by A. A. Thompson, of Dayton, Ohio, readily becomes an extension ladder. Notches in its top step permit the ends of the side rails of the back half to slide securely into metal loops fastened to the side rails of the front half.





COOKIES CAN'T STICK to this cutter designed by Louis Frank, of Fellows, Calif. It contains a plunger and perforated disk, which force the dough out of the utensil as soon as it has been cut and decorated by pins set in the cutting end. When she wants to operate the plunger, the cook thumbs a flat lever that curves around one end of the cutter's handle. A coil spring surrounding the plunger pulls it back in place after it has done its work.

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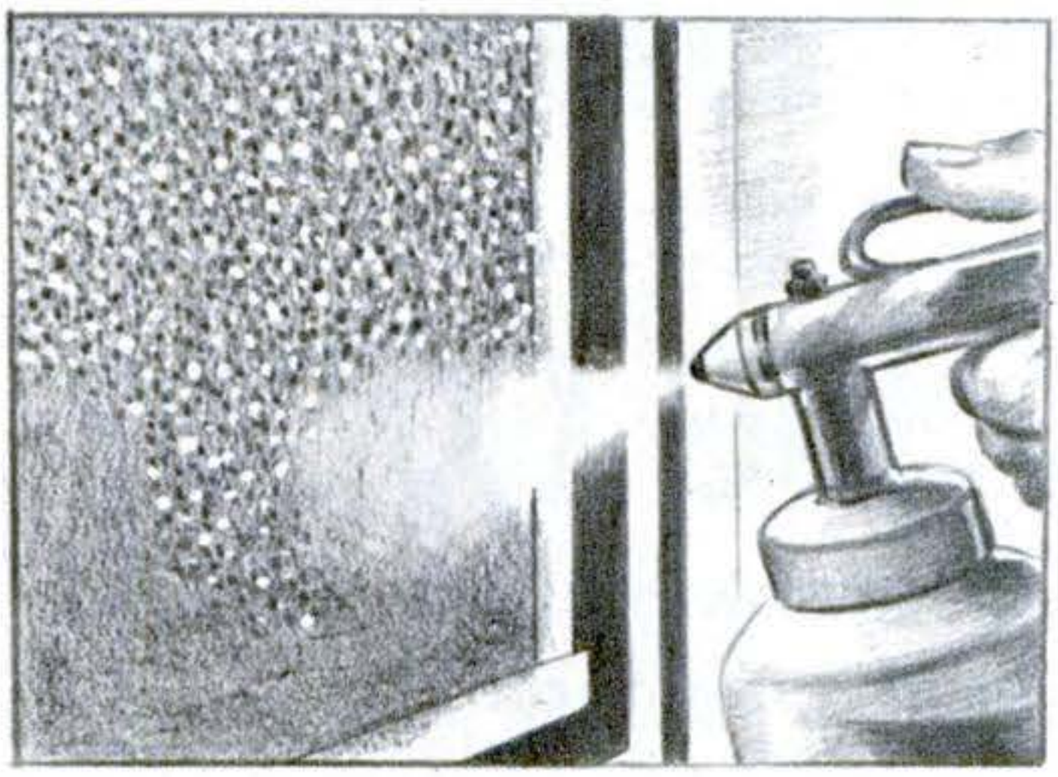
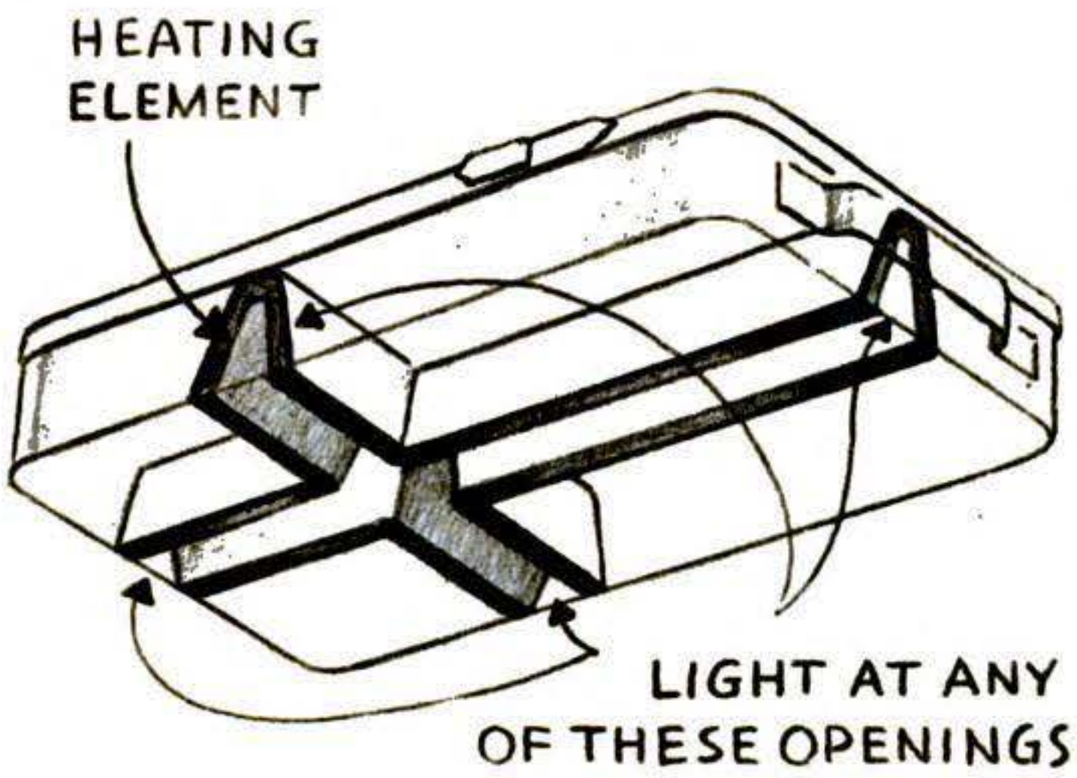
THE INVENTORS

MOTHER'S HANDS ARE FREE when she uses this baby carrier. Lydia Chamberlain, of Three Oaks, Mich., devised it to enable a person to carry a child in a normal position without having to hold it. The carrier is made of strong but light, washable fabric and is like a pair of pants on the end of a sturdy strap. The strap can be slung over either of the wearer's shoulders and its adjustable buckle fastened to a secure button in the reinforcing strip, which belts the back of the carrier. A flap, extending upward from this strip, supports and protects the baby's back. The carrier may be used as a baby harness, too.



A COAT OF MANY COLORS can be applied to any object you want to paint, if you use a formula worked out by Peter Busch, of Newark, N. J. He has devised a milky base liquid into which he can pour paints of four different colors without having them mix. The liquid contains an ammonia solution of casein, alcohol, and acetone When he pours varnish enamels of various hues into this liquid, they break up into separate drops. He warns users not to try to apply this multicolored paint with a brush; that presses the drops into each other. It's best to spray it on.

HOT FOOD IN THE FIELD is the object of a self-heating ration container, invented by N. T. Naranick, U. S. Army, Casper, Wyo. He proposes to seal rations in a shallow, rectangular metal container with two intersecting, V-shaped grooves in the bottom. It is his idea to line the grooves with a puttylike chemical, which will burn for about five minutes without smoking in any weather. The chemical would leave a thin char which would help retain heat in the container. A person using this container breaks the seal by unwinding a metal tongue at the edge of the lid. He then attaches a two-pronged holder and lights the end of any groove.



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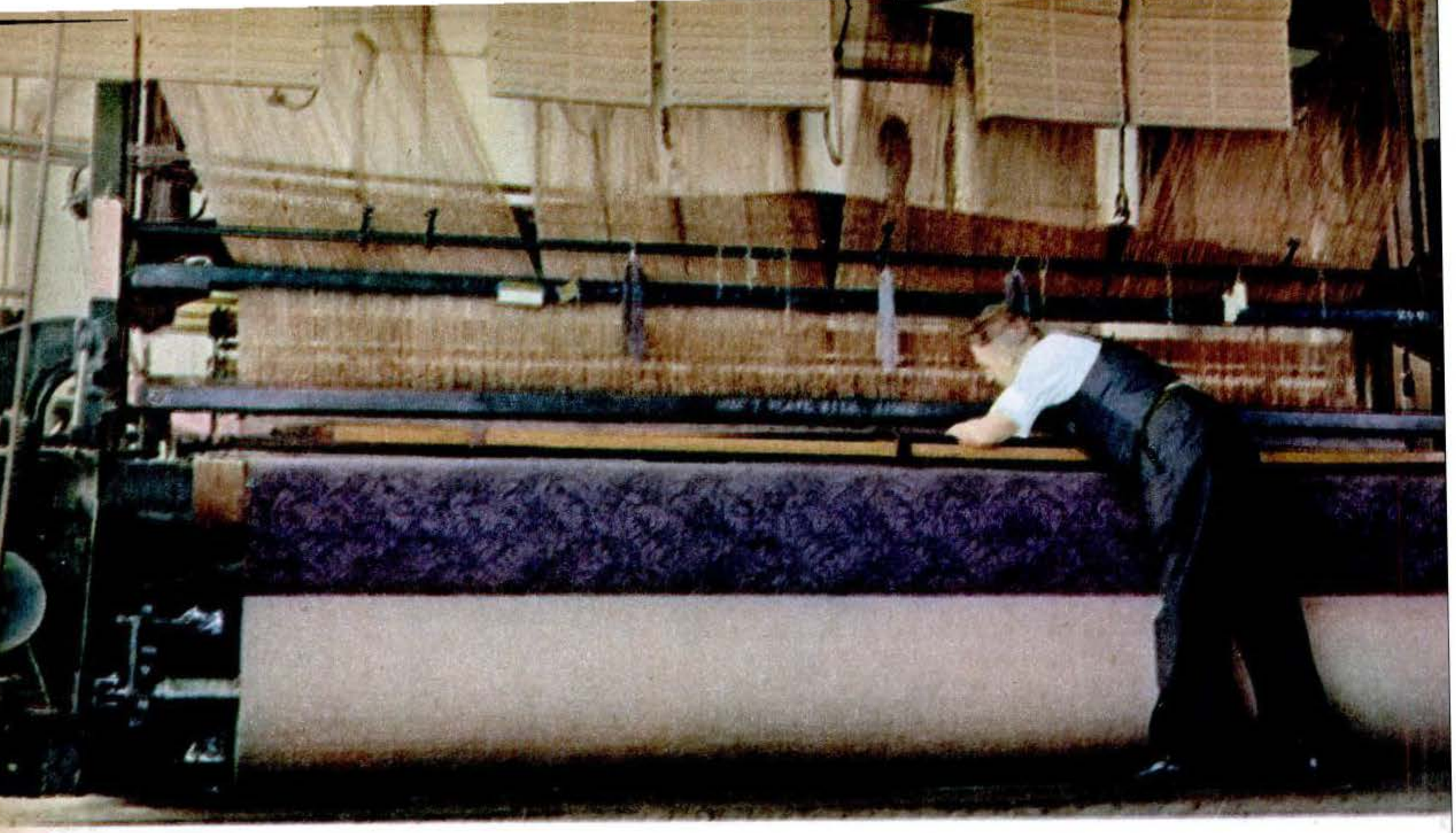

A loom turning out figured Wilton carpeting. This loom weaves 256 lines of wool every 27 inches of width and 11 loops to each running inch, giving it more than 100 loops to the square inch—a high-quality carpet.

WHAT MAKES A RUG GOOD?

New carpets are coming, but knowing how rugs are made still helps in judging quality.

Close-up of "textured" carpet, a new development in rugmaking. The relief effect is produced by leaving the pile uncut in loops of varying lengths.

By GOLD V. SANDERS

Photographed by WILLIAM W. MORRIS at Karagheusian's Carpet Mill

IF YOU are among the millions who have been hiding the bare spots in the parlor rug during the war years, you should know what the carpetmakers have on the looms before you rush out to buy that new rug.

There are some new wrinkles in this centuries-old trade. And that is literally true—some of the new weaves have a crinkly effect, others have a sculptured texture. These new types of floor coverings add the third dimension to pattern and color under foot. Weaving methods produce the relief effect, and such carpets are called "textured," to distinguish them from those with level pile and colored figures.

American women may take credit for some of this new life in the carpet industry. It was their taste that started it just before the war. For several years there has been a preference for solid-color carpets, but the plain velvets showed footprints. In creating one-color carpets that would not track, the manufacturers at the same time achieved

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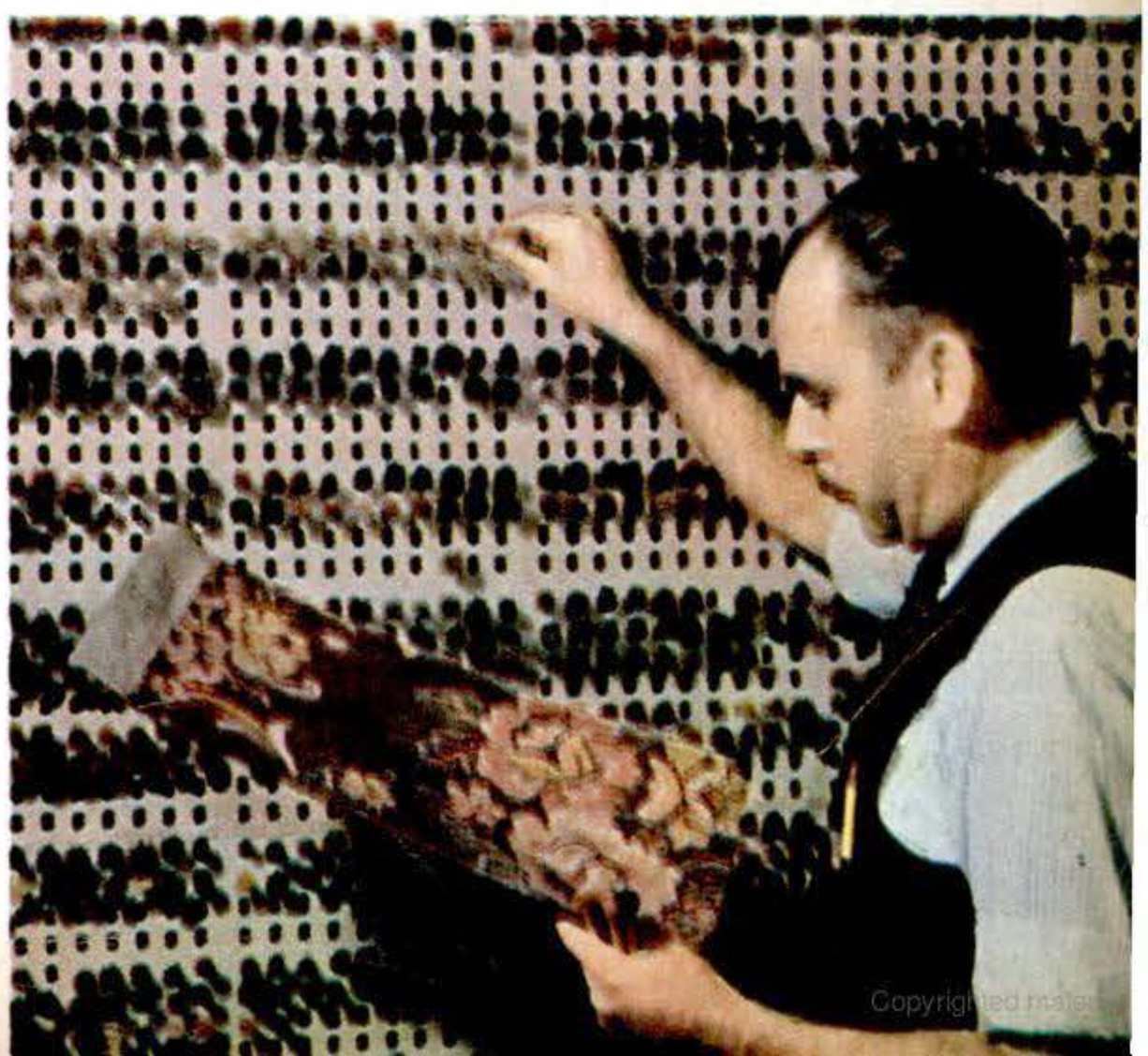
Laying the original design on a carpet shows how well complicated manufacturing processes reproduce the pattern. Designs are made in water colors on square-ruled paper; each square represents a tuft of wool.

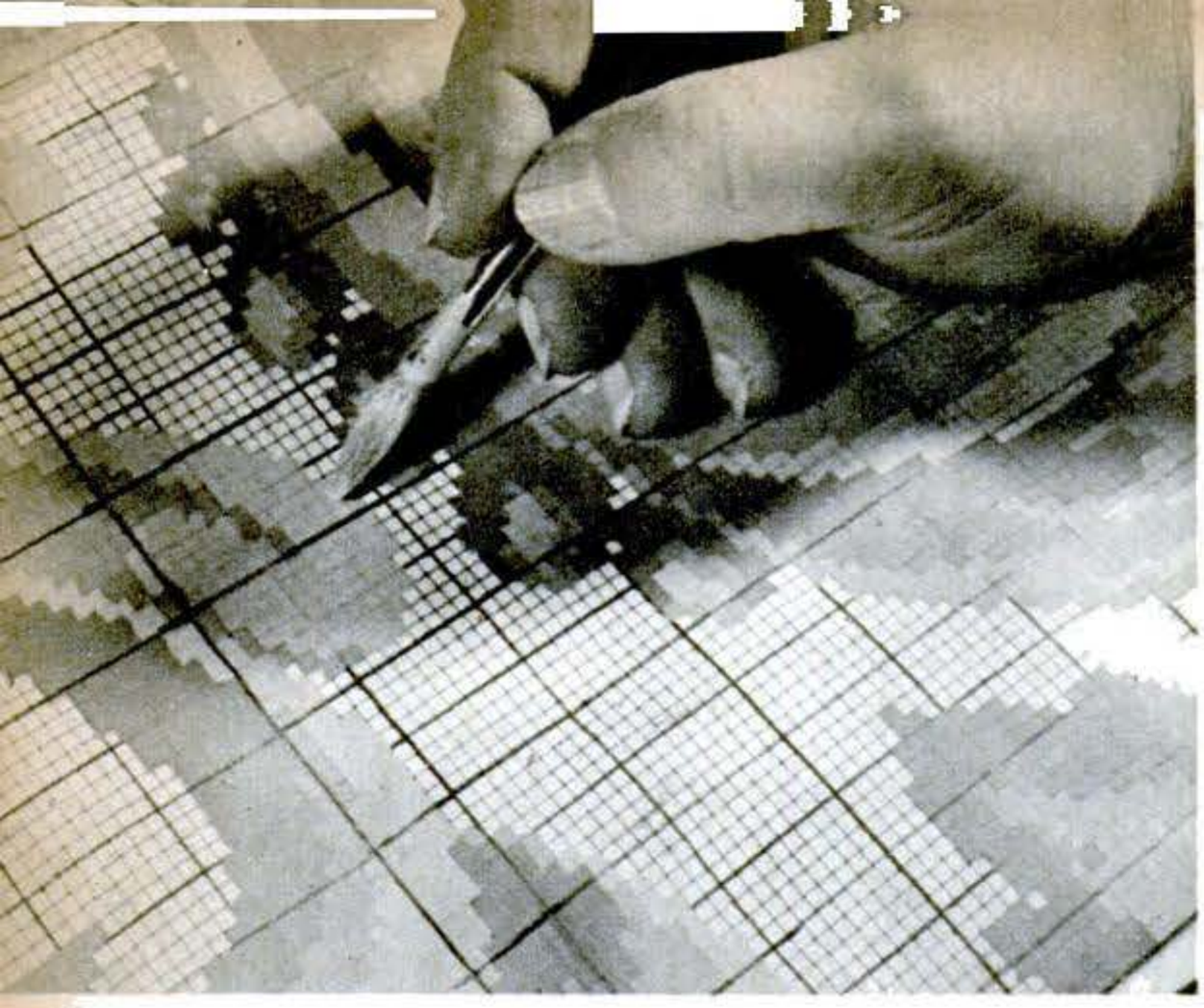
some really remarkable new surface effects.

This is not to say that the old stand-bys produced on Axminster, Wilton, and velvet looms are going out of the picture. They will still be turned out in large numbers, and not all manufacturers will produce new types. Axminster, the lowest-priced pile rug, has been the leader in the American market for many years. It will probably maintain its leadership for more years to come. The new "three-dimensional" carpets will compete more directly with the Wilton figured rugs and with plain velvet. They will be in a price class with the best of these types.

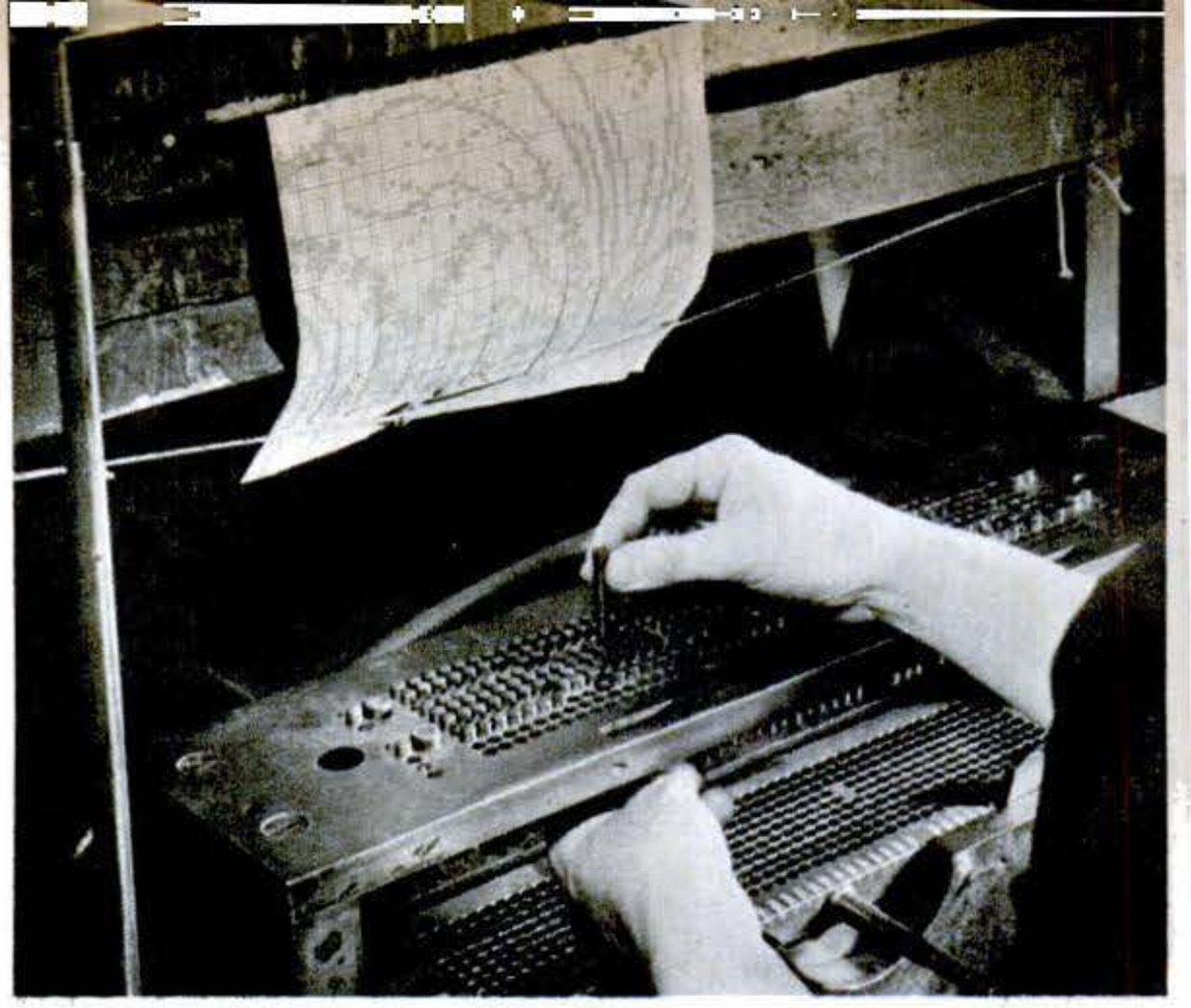
The new carpeting is woven on regular Wilton looms and, therefore, has the same inherent high qualities that come from this type of weaving. The height of the pile is governed at the loom by the height of the "wires" used in weaving it. The thickness of the pile depends upon the number of these wires to the inch and the number of lines of warp. So the new types of carpets

A skilled matcher at the A. & M. Karagheusian factory, Freehold, N. J., translates a designer's painted pattern into dyed wool. He determines the exact shade of yarn to go into each tuft. The rack from which he is choosing his colors, which are keyed with numbers, holds thousands of tufts of yarn.





A figured Wilton rug is conceived on the designer's square-ruled paper. His brush fills each square with the proper color. The design then goes to a card puncher who reads it like sheet music, line by line.



With a guide rule holding design in place, the operator sets a punch to correspond with the color of each square. Each card determines the color of only nine inches of one line (the weft).

may differ from one another in quality, just as other Wiltons do.

In weaving a Wilton or velvet carpet, all the wires have blades at their ends that cut the loops when withdrawn. This produces the standing pile. In one variety of new rug, some of the wires have knives and others do not. By using these in a certain sequence, a carpet is produced that has loops for background and standing pile to form a figure. In another type all the pile is in loops but of varying heights. The pattern of these carpets is still automatically controlled by the ingenious Jacquard "piano roll" method that has produced our Wiltons for several decades and our Brussels even longer. A smooth-surface Wilton is nothing more than a Brussels carpet with all the surface loops cut.

What makes quality in a carpet? The best way to know quality is to understand how carpets are made. The first thing to look for is *closeness of weave;* that is, the number of tufts of wool to the square inch. Looking at the back of the rug helps. Here you can count the number of rows to the inch in each direction, the weft and warp threads. The warp runs lengthwise and the weft crosswise. Multiply the two figures and you have the actual number of tufts to the square inch in the surface. If this count is around eight or nine in each direction it is a high-grade rug.

Next in importance is the *height* of the pile. If it is long and still stands up firmly under pressure, it is in the luxurious class. But even if it is short—say $\frac{3}{16}$ inch high—it is a good rug if the pile is thick and stands firmly. It should have the springy feel of a golf green. The length of pile in American machine-made rugs varies from .145 inch to .500 inch.

Bending back the face of the rug is another good way to check closeness of the weave. In a high-grade carpet with tight pile you will hardly be able to see the backing at all. In a loosely woven piece the backing is visible. The pile may have been made extra long to cover up its sparseness, but this fact shows up when you bend it. Furthermore, a long pile will not stand up under pressure unless there is lots of it to the square inch. Some of the new textured carpets are an exception to this general rule. Constructed with many loosely woven loops, they may expose the back when folded, though they are of fine weave and good quality.

The best machine-made rugs are generally Wiltons. The process which produces them permits a finer weave than is possible on the Axminster loom. A very high grade of Wilton will have about 100 tufts of yarn to the square inch. The finest Wilton has 123 tufts. Each tuft consists of the two ends of a cut loop.

A solid-color rug is usually called velvet. It is woven on a loom similar to the Wilton but minus the elaborate Jacquard system that fixes the colored pattern. A velvet, of equivalent grade, however, will not be quite as thick and resilient as a Wilton. The pile may be just as thick and high, but in the Wilton of equally fine weave there will be many strands of the wool yarn lying in the body out of sight.

This comes about as a by-product of the Jacquard system. If a Wilton is of five colors it means that five strands of yarn occupy each "reed space" on the loom,

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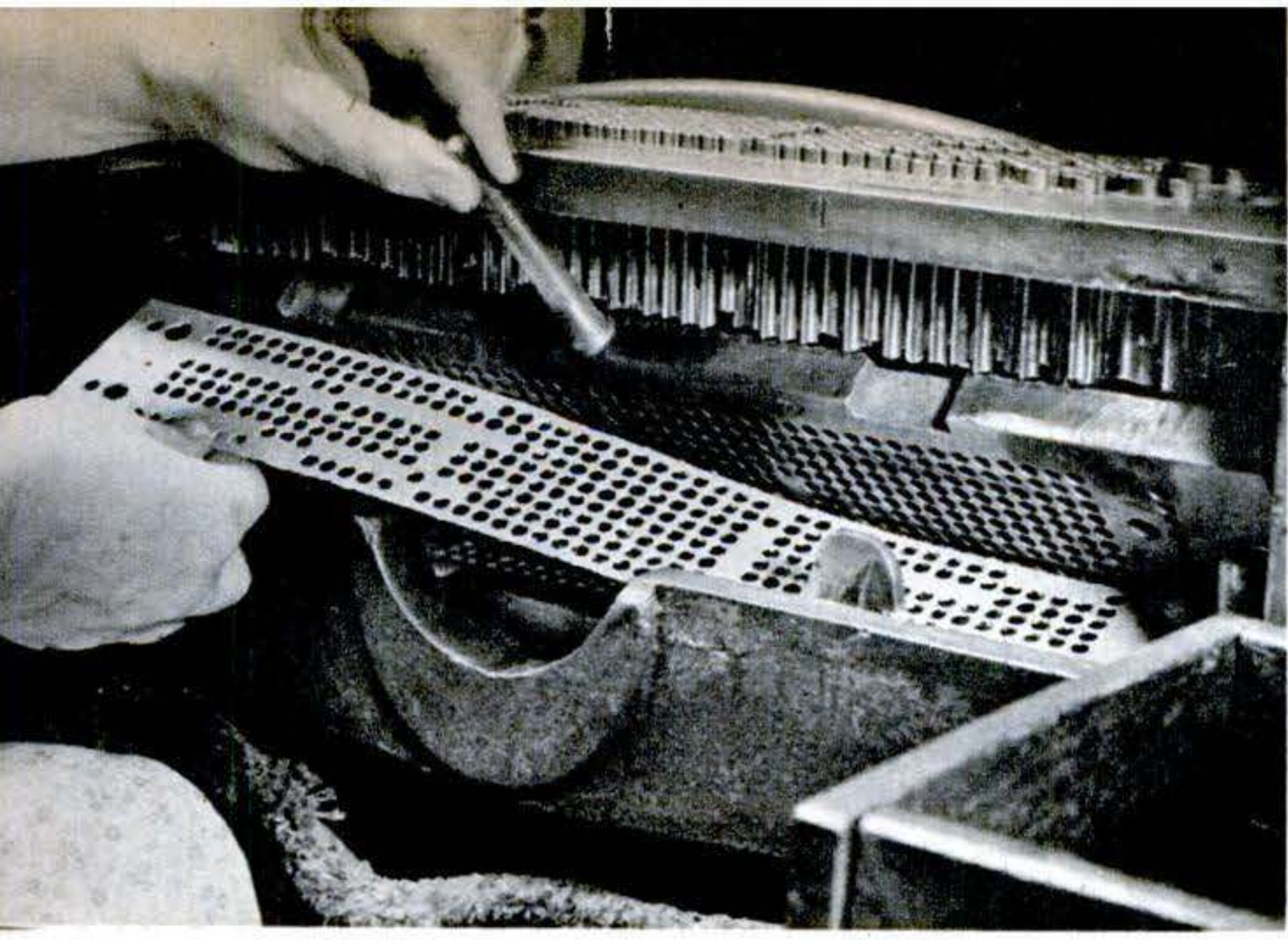
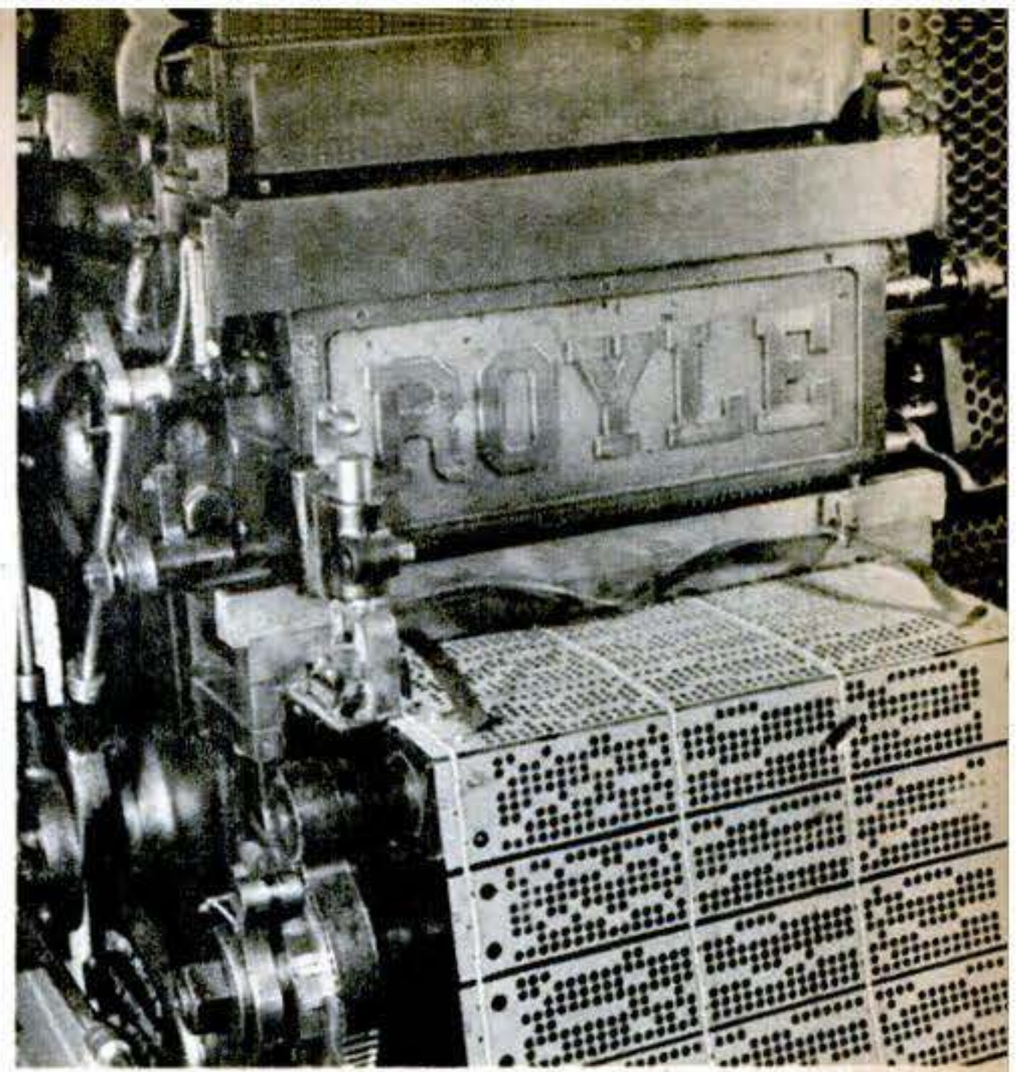


A 9 by 12 Wilton may require as many as 11,000 cards, and all Wiltons, because of intricate process by which they are made, are limited to six colors. Color-selecting card method was devised in 1801 by J. M. Jacquard, a French weaver.



After all cards required to complete one design are punched, they are run through this duplicating machine to make more sets for repeat designs.

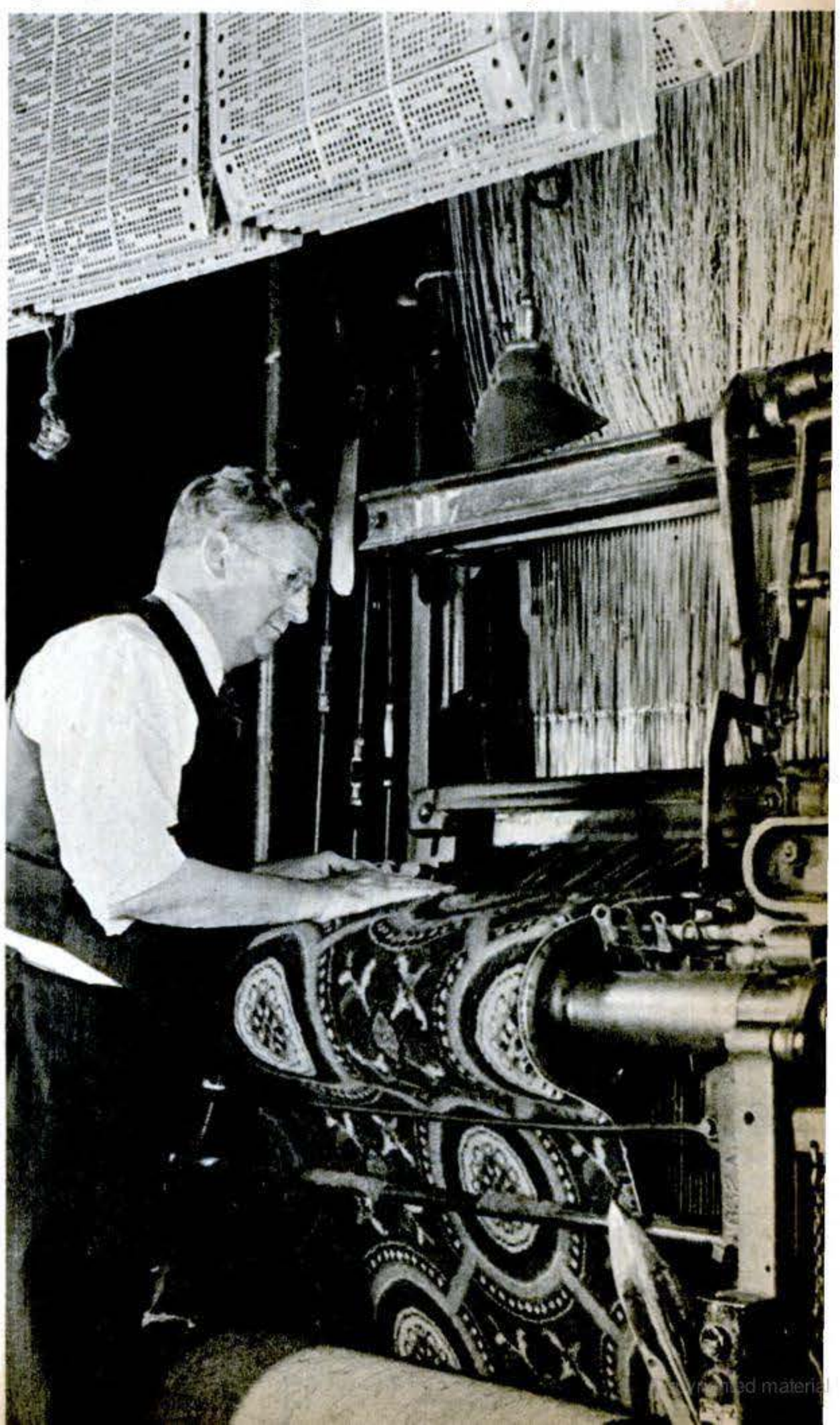
there being one of these spaces for each row of warp. But only one color is raised in each space at each "pick" or crosswise line of the carpet. The other four strands of wool remain beneath the surface. At the next "pick," a different color may be raised, but four strands always remain hidden. They do not show, but they add body and spring to the carpet. Therefore, the more colors there are in a Wilton pattern, the thicker the cushion under the pile will be.

Axminsters are woven coarser, as a rule, than Wiltons. Whereas the standard "pitch" of Wilton is 256, that of Axminster is 189. What this means to the user is that there are 9½ and 7 lines of warp, respectively, to the inch. In the other direction, there are even greater differences in the number of rows per inch. The average Axminster has 51 tufts to the square inch and the cheapest may have only 28. Generally, the pile in Axminster is longer than in Wilton. It should be borne in mind, however, that lower-quality Wiltons can be made, too, and that a good Axminster is better than a poor Wilton. There are Axminsters of really fine quality made, such as those with seven and nine rows to the inch.

One of the common misunderstandings in carpet buying is the word "broadloom." It does not designate any type of weave or any class or quality of carpet. Any loom over four feet six inches in width is called a broadloom in the industry.

There are also misnomers in the carpet business that are more likely to mislead than guide the purchaser. One of these is "Wilton Velvet." A carpet must be one or the other, if the standard terms used in the industry are observed. Another impossi-

Hundreds of pattern cards hang above loom making 27-inch-wide Wilton. The spaghetti-like cords in the background are used to lift the right yarn to the right place at the right time, making the design.



The point of the loom where the magic of the Jacquard method transforms the yarn into a patterned Wilton rug. Note line of wires (left center) over which wool is looped to form pile.

Back and forth across the loom a shuttle carries the weft yarns which bind in the loops of the surface pile yarn. It passes between the raised warp yarns (pattern makers) and the buried colors in the body of carpet.

Behind the Wilton loom are the yarn-bearing frames, each frame having yarn of one color. A thread of each color for every tuft in a row across a carpet is fed into the loom, but only one appears on rug.

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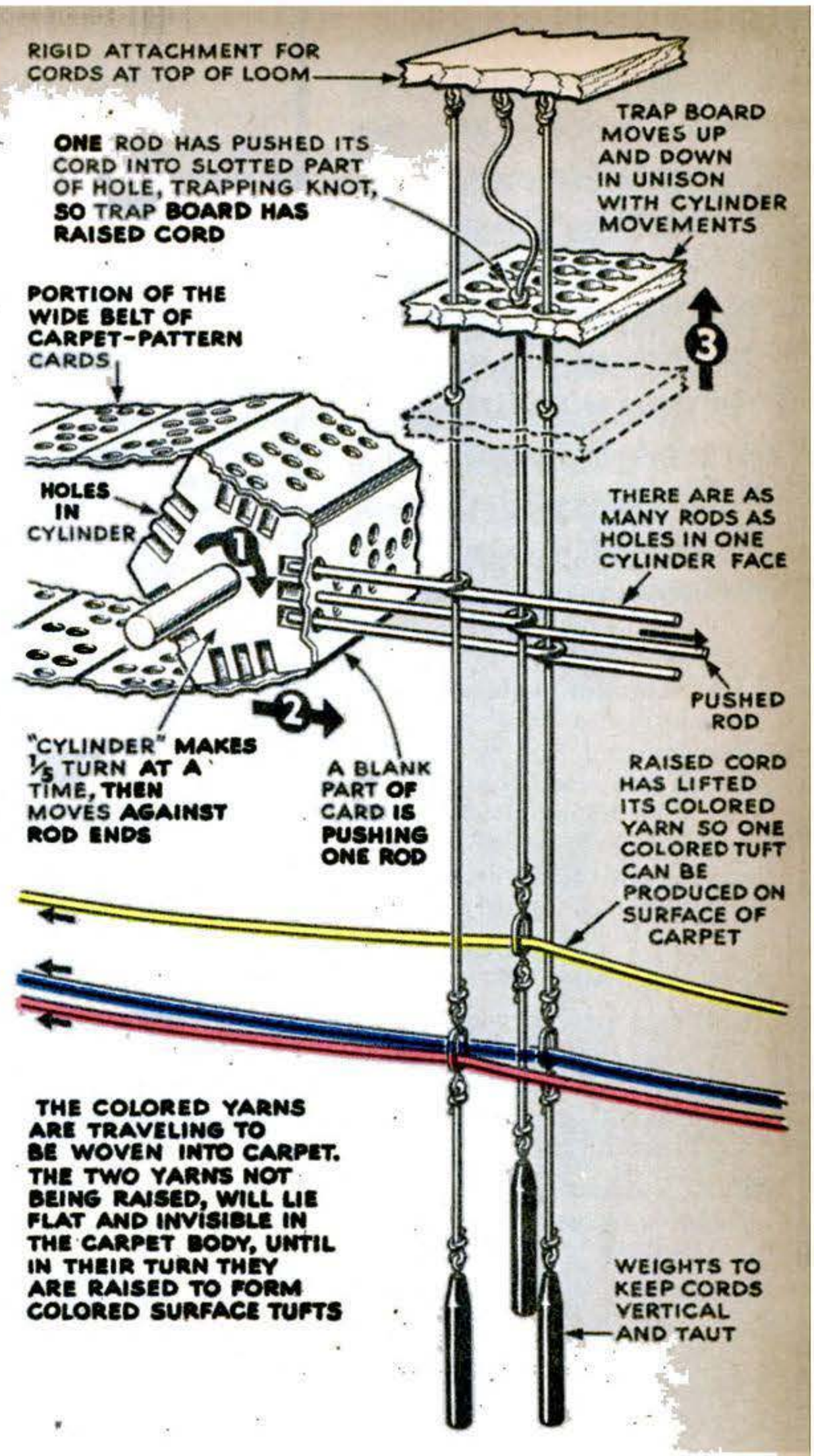
Loops of warp yarn formed on wire may be seen in left side of picture. As wire is withdrawn, a blade (arrow) on its end cuts the loops to form upstanding pile. Height of wire determines depth of pile.

bility is "American Oriental." There is no such thing, unless one were willing to say that a machine-made rug woven to a typical Oriental pattern is it. Genuine Orientals are all handmade, and the fine grades have about twice as many tufts as the best Wilton. Rare Orientals have as many as 600 hand-tied knots to the square inch. This closeness of weave is what makes them superior to machine-made rugs. The sheen common to Orientals is now duplicated by American manufacturers with chemicals.

Wool quality is also important in appraising a carpet. Don't look for the same fine, soft wools in carpets that are used in suitings. The best carpet wool is coarse. None of it comes from American sheep because they have been bred constantly toward greater fineness of fleece. Carpet wool comes from all over the world—Asia, South America, and Europe. It comes in duty free because it is not in competition with the product of U. S. producers. Carpet manufacturers take the wool from six or eight different localities and blend it to obtain desirable combinations of stiffness and toughness. These grades of wools vary in quality and, after skillful blending, go into different grades of carpets.

Another thing, the yarn in a carpet may be of two, three, or four ply, and this can be determined by examining a single tuft. But this alone is not a reliable index to quality. A four-ply yarn, woven loosely, will not make as firm a pile as two-ply, woven closely. Thick yarn may produce a good-looking surface, but examination of the back of the carpet will reveal a coarse weave.

Color and design are still probably the basic factors in selecting a rug, but color and design do not always determine quality. A knowledge of how rugs are made will be helpful in selecting this important part of the modern home.



This schematic drawing shows how the Jacquard pattern card automatically chooses the right-colored yarn to be raised for each tuft. The cards are fed to a five-sided, rug-width cylinder (1), which pushes (2) against a row of rods, catching certain cords in slots of the trap board. When the board rises (3), it pulls up those cords, bringing the proper colored yarn into place to form the tufts.

ON the two following pages the differences in the construction of Wilton, Velvet, and Axminster carpeting are clearly shown in diagrammatic drawings. Photographs showing various stages in the weaving of Axminster carpets are also presented. Velvets are made much the same as Wiltons.

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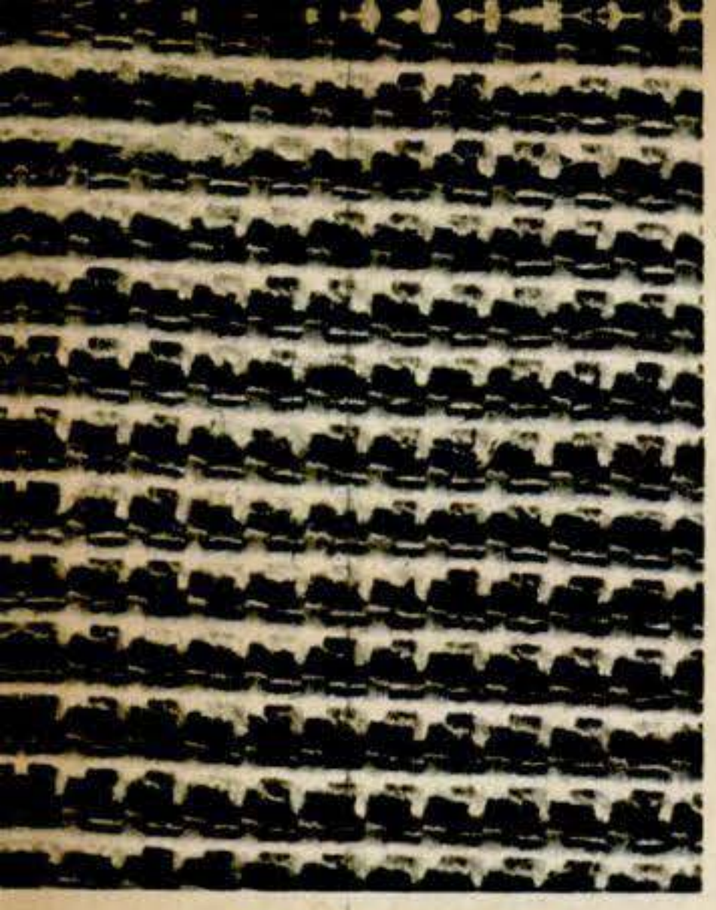
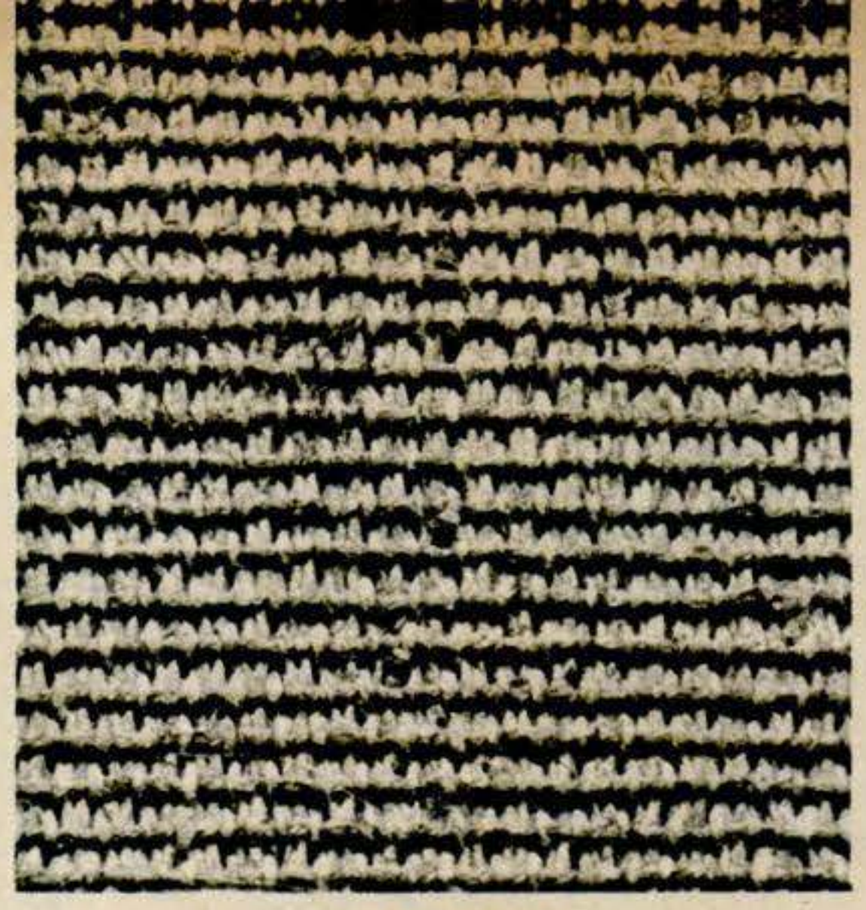


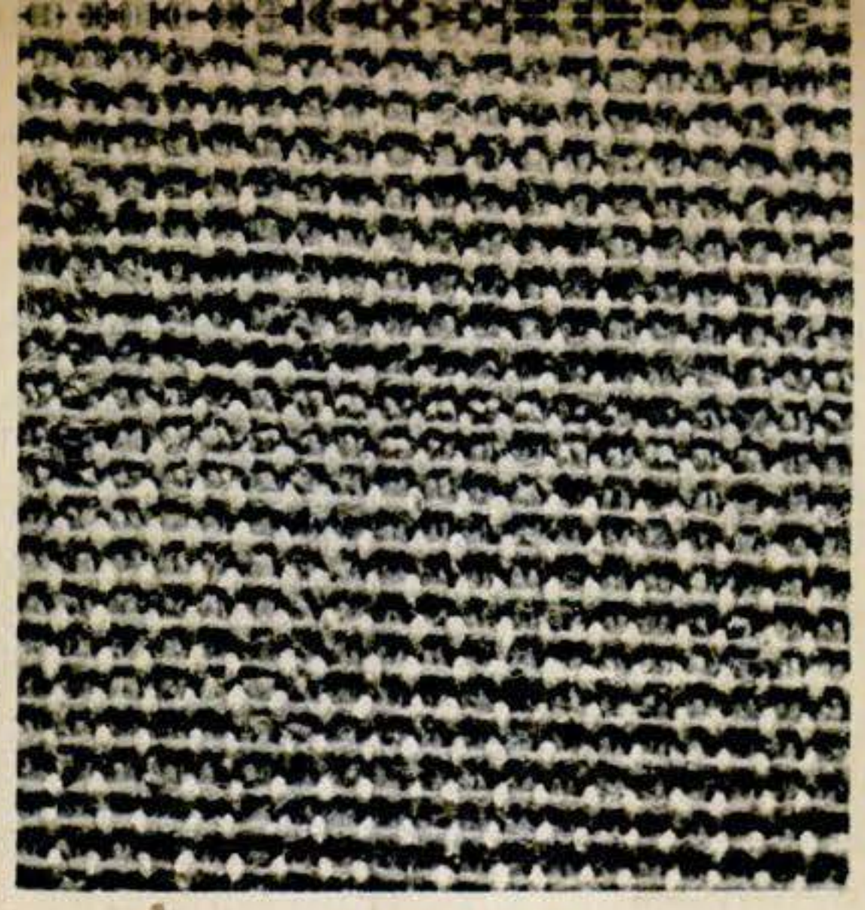
AXMINSTER

The essential feature of the Axminster is that the tufts are inserted row by row between the warp threads and are then bound down by the weft (filler), which is shot across and back the carpet's width by a great needle.



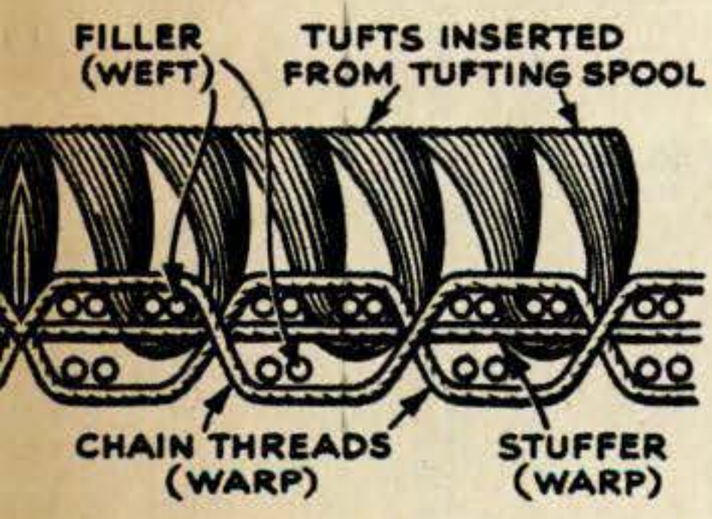
VELVET

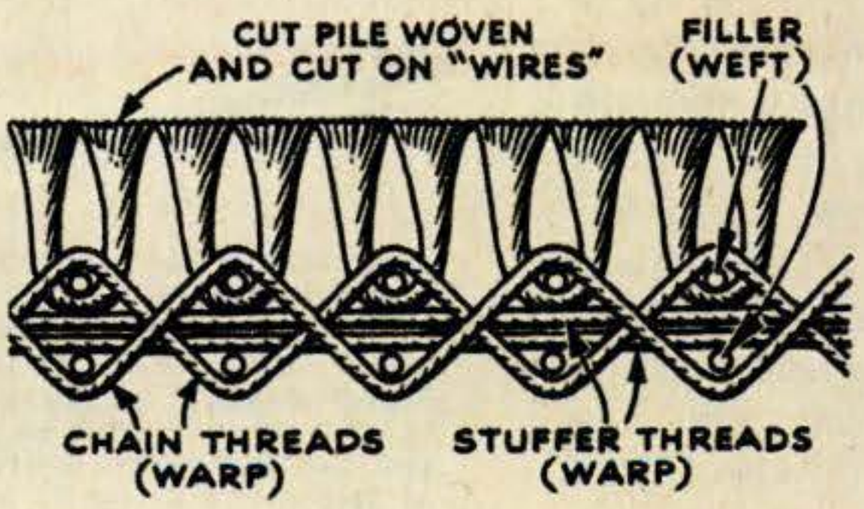
Velvet, usually solid-colored carpeting, is the simplest of all carpet weaves. It is woven on a loom similar to the Wilton but minus the elaborate Jacquard system that fixes the colored pattern. The yarn can be dyed before or after weaving. Quality of velvets is determined by the number of tufts to the square inch.

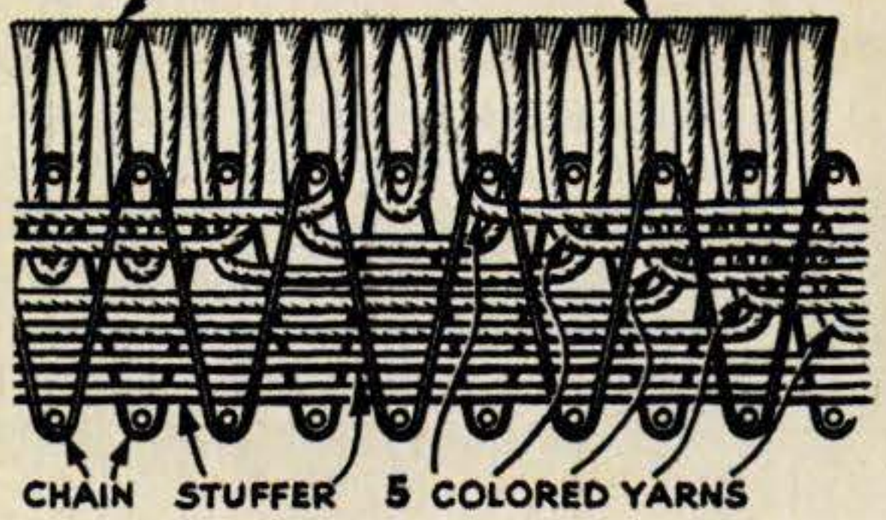


WILTON

The standard Wilton quality has 100 tufts to the square inch; finer qualities have about 125. In a five-color rug, as in cross-section drawing, only one color appears on the surface at any given point, the other four lying underneath.







SETTING AXMINSTER YARN. Following a line weftwise across the design paper hanging above, these skilled setters assemble spools of colored surface yarns which are wound upon a loom spool to provide a similar row of tufts in the finished Axminster fabric. Loom spool is visible between the two rollers.

WEAVING AXMINSTER. The loom spools, riding on a continuous sprocket chain to effect the design, drop into place to form one line of weft at a time. A complete revolution of the chain weaves a whole rug.

CLOSE-UP OF SPOOL. Each strand of surface yarn on the rug-width spool is threaded through a slender guiding tube to assure its proper position as it comes between the warp threads. After each strand is folded back, a knife snips the entire row. The spool goes back on the chain, making way for the next one.

The gaudy Roc's "shroud" wing, which the operator tilts by radio control when he wants to turn the missile, was designed to save space in crowded bomb bays. But it has the same airfoil cross section as a regular wing, provides nearly as much lift as a straight wing of the same area, may be used on future airplanes.

"ROC," NEW SKY TERROR

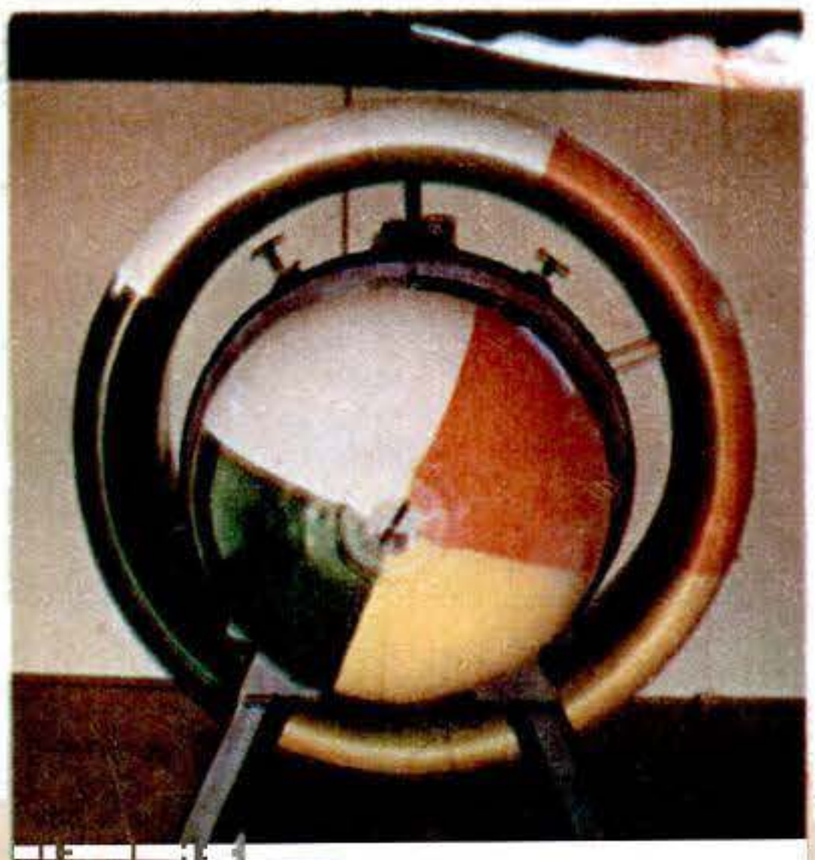
This radio-controlled missile, painted like a circus wagon, televises its view of the target to distant launching plane.

THE Roc, a radio-controlled bomb named for the fearful bird which Sinbad the Sailor encountered, is one of the new guided missiles which may help preserve peace or win another war. A product of Wright Field's ATSC and Douglas Aircraft Corp., the bomb is brightly painted, has a television "eye," and a round "shroud" wing.

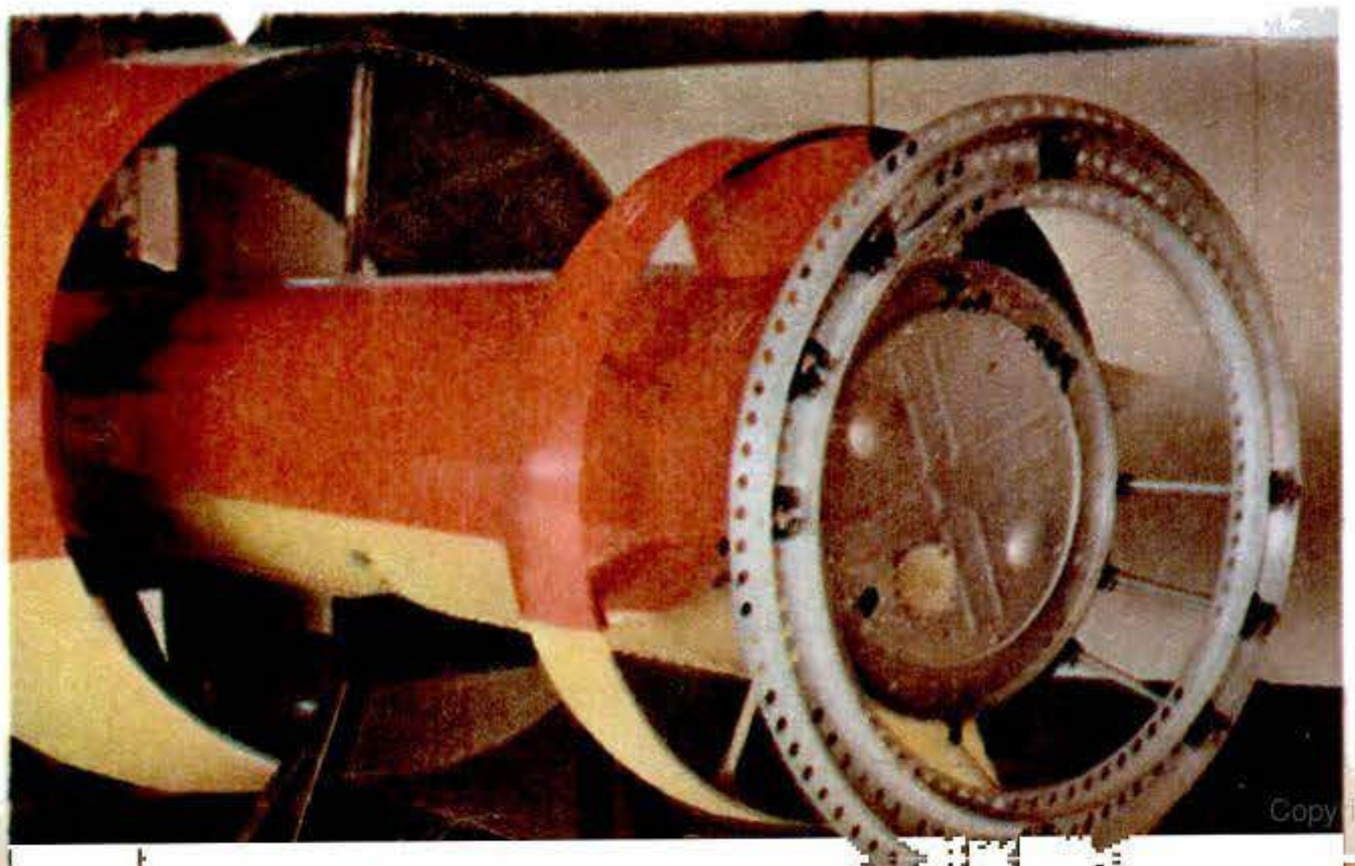
Its vivid colors enable the bombardier to watch and control the flight of a Roc bomb accurately when he launches it on a flat glide toward its target. He knows which way to tilt the shroud wing by radio and turn the missile, according to what color he sees. He maneuvers the Roc by means of a compact control box which sends radio commands to a receiver in its tail. The bombardier then turns to his television screen, which shows him what the bomb now sees through its "eye" and is televising to the plane. Thus, he guides the Roc all the way to its goal.

Authorities say that the Roc, Navy "canards," and other guided missiles can be made to contain atom-splitting gear.

What the bomb "sees" through the television "eye" at the tip of its nose, the bombardier or ground operator also sees on his television screen.



The combination drogue and radio antenna attached to the Roc's tail stabilizes its flight just as feathers steady an arrow. This tail assembly also slows down the bomb somewhat, making it appreciably easier for the operator to control the missile.



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Looking for evidence of radioactivity in ore chunks, a radium expert times his electroscope's reactions.

HOW TO HUNT FOR URANIUM

Prospecting for the source of atomic power calls for scientific instruments as well as for pick and shovel

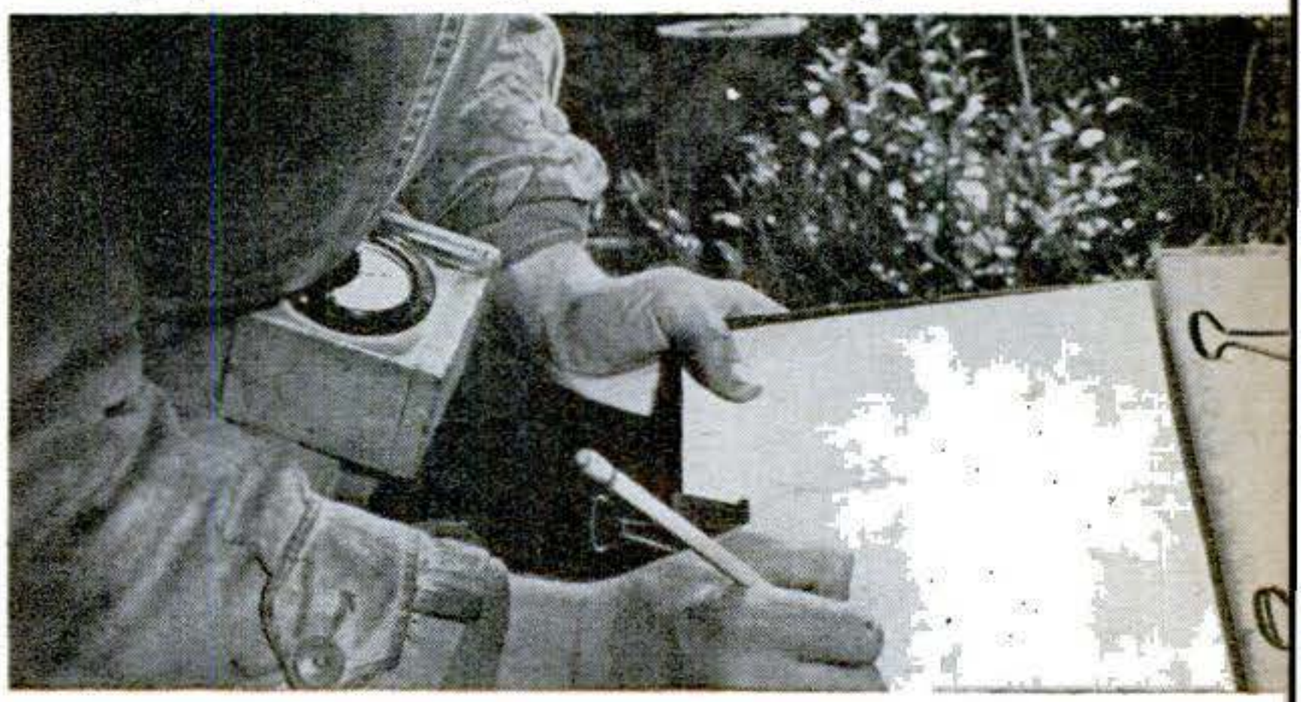
URANIUM, long the homely sister of the glamour metal, radium, is now the Cinderella of the Atomic Age. It stands 25th among the elements in order of abundance, but is scattered so widely through the earth that only a few large deposits are known. Major strikes may be made at any time, almost anywhere.

Uranium prospecting, however, will never be a mass scramble like the old-time gold rush. No claims can be staked on public lands; they've been withdrawn by Presidential order. Private prospecting is still possible on private property, but there is only one customer for uranium ore—the Government. Still, there are thousands of old mines to be reprospected in areas where uranium is a possibility, and riches will reward the lucky discoverers of new sources of this mineral.

Uranium-prospecting equipment costs $200 to $500. An ultraviolet lamp, a sensitive and sturdy electroscope, and a Geiger counter with batteries and headphones are needed, along with some chemical reagents, a package of film wrapped in lead foil, and a portable developing kit. The electroscope and Geiger counter are not both essential. Experts advise the counter, if a buyer must choose.

More than 100 minerals are known to

Radioactive ore makes a Geiger machine click like a telegraph key. Soundings of one are being charted.



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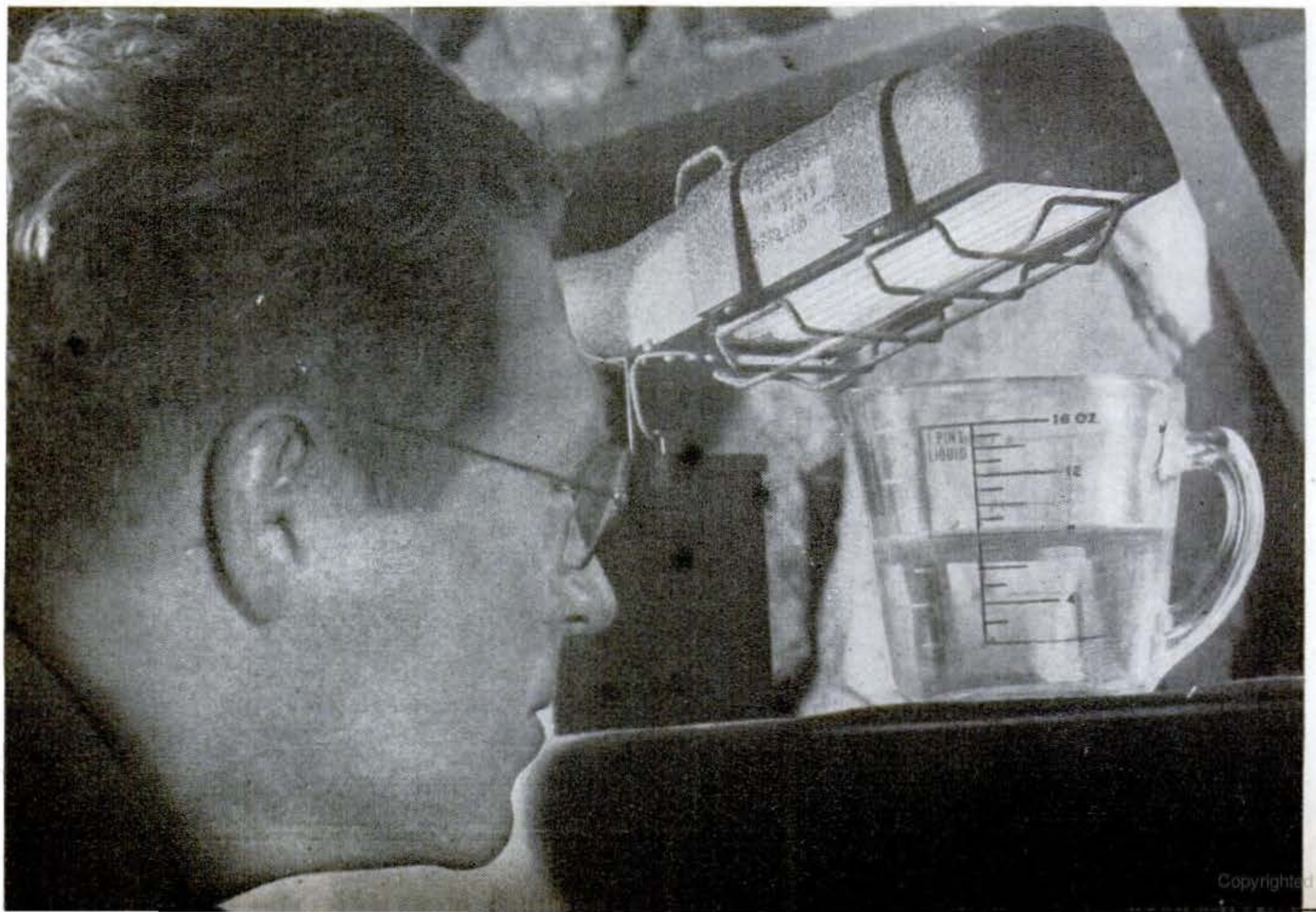
This "photograph" of a key was made by rays from a piece of radioactive ore.

It may take several days for a weakly radioactive mineral to produce an exposure like the one shown.

contain uranium, but two have yielded the bulk of the world's product. Pitchblende is glossy, brownish-black, hard as steel, and is found among veins of silver, iron, zinc, or cobalt. Richest U. S. sources have been the pegmatites of New England and North Carolina. Carnotite is a soft powdery mineral with a bright, canary-yellow color. It is found in sandstone and shale.

Uranium-bearing substances help the prospector because they are radioactive and therefore send out impulses to guide him to

A yellow "collar" on an acid solution of ore under ultraviolet light proves the ore contains uranium.



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them. That's why the electroscope and the Geiger counter are needed.

Early electroscopes consisted of a pair of tissue-thin gold leaves suspended from a metal rod. When a charge of static electricity was applied by rubbing a comb or a bit of amber, the leaves repelled each other and flew apart. Rays from uranium quickly ionize the air, causing the electric charge to leak away and the leaves to fall together again.

A modern electroscope contains tiny gold-plated fibers of quartz, which the prospector observes through a magnifying eyepiece. When he nears a radioactive deposit, the fibers promptly fall together. To interpret their action, he must first have taken readings to find out how long it normally takes for the charge to leak away. This is a reference standard that should be used to check all field investigations.

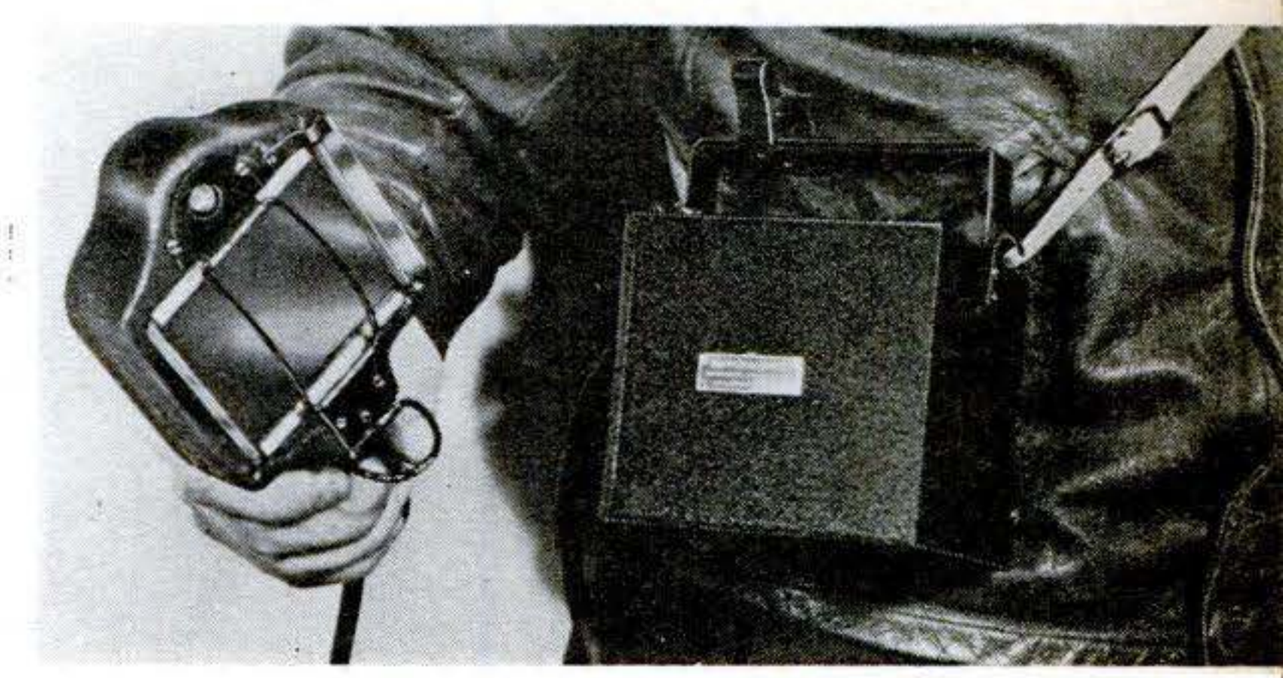
More sensitive is the Geiger counter, which has a gas-filled glass tube containing a hollow metal electrode with a tungsten wire in its center. Any radioactive ray will trip off a brief discharge from a battery in the circuit, causing a click in the headphones that the user wears.

The Geiger counter, which costs about $150, is strapped to the back, its electrode carried in the hand. The headphones immediately pick up a sharp clicking, but it doesn't necessarily indicate uranium is near by. These clicks come from cosmic rays, and are more or less constant throughout the world. In barren country, the ticking may average one every three seconds, but when the prospector nears a uranium deposit, the counter begins chattering madly.

First, the rate of the cosmic-ray background must be established, by putting the counter on the ground for five minutes and averaging the number of clicks per minute. This should be repeated at several points to get a true average. The course should be laid out systematically and observations taken every 50 to 100 feet, timing each count carefully. Stakes should be driven into the ground, given numbers, and the data entered in a notebook, preferably in the form of a rough map so that the spots of greatest radioactivity will be clearly evident. In this way, a quantitative estimate of the richness of the showing can be computed at the end of a day's prospecting. The faster the instrument discharges, the richer the specimen.

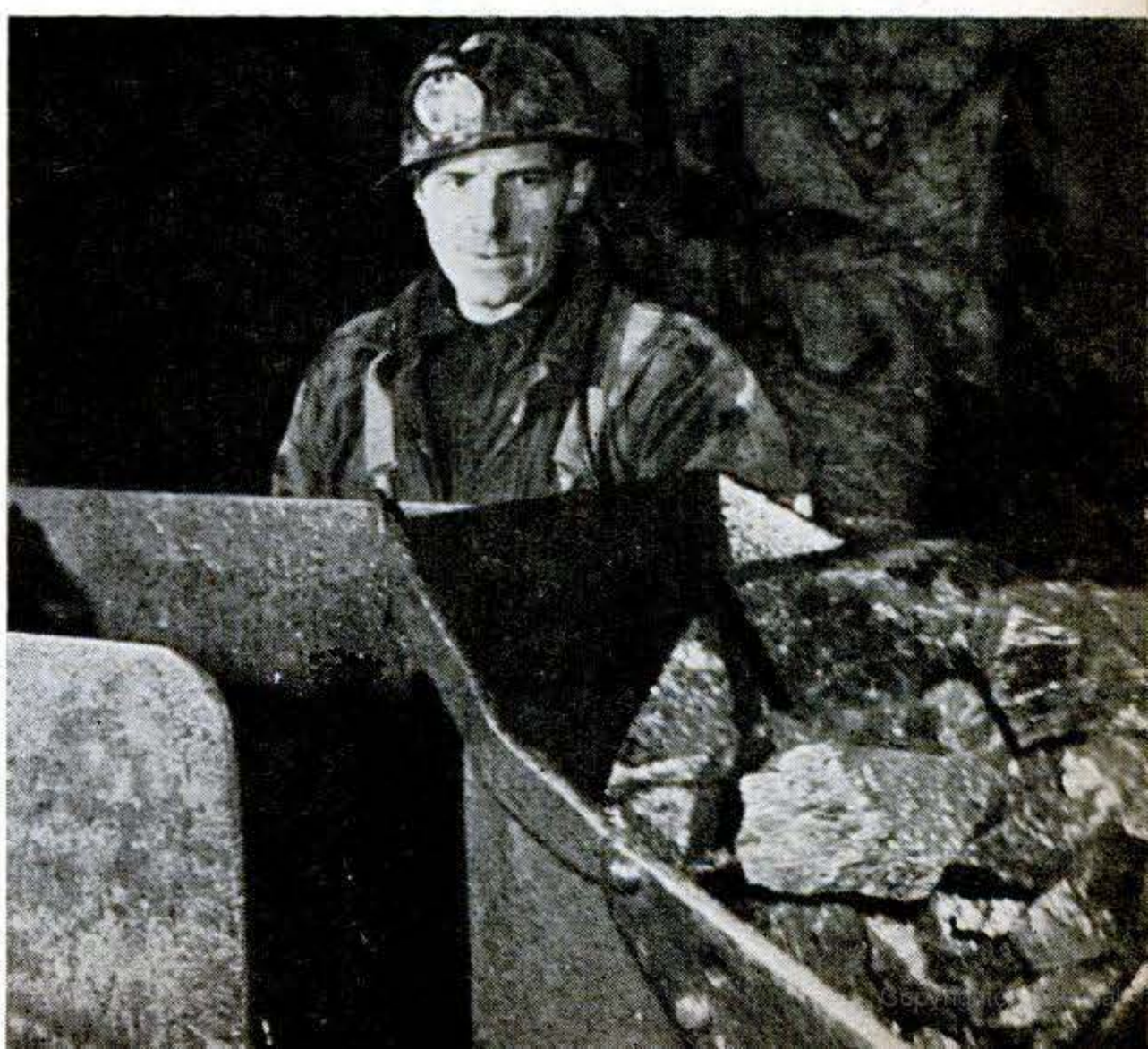
Samples of rock believed to be radioactive should not be loaded in pockets; they prevent accurate readings. Dust or sand, which often is radioactive, collects on the instrument case or in trouser cuffs or pockets. Allowance sometimes must be made for the shielding effect of a cliff or forest on the pulse of the cos- *(Continued on page 208)*

Prospectors often pan for uranium-bearing gravel; test it for telltale glow under ultraviolet lamp.



An ultraviolet hand lamp, which makes "tracer" minerals gleam, is most useful for night prospecting.

Canadian pitchblende miner comes up with a load of the ore, which is the principal source of uranium.

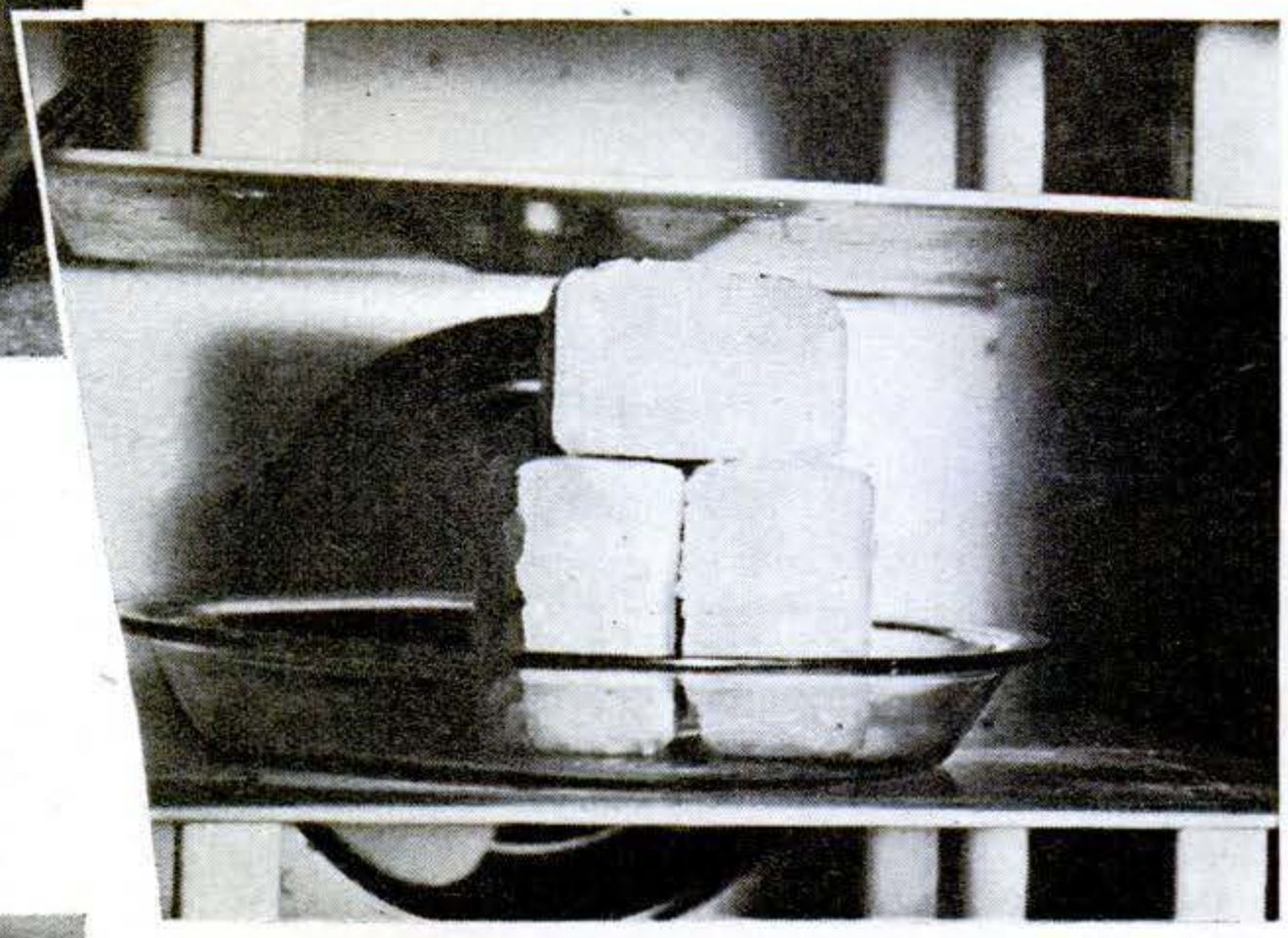


Science Works with FOOD

HIGH-FREQUENCY HEATING UNIT KILLS BREAD MOLD, SAVES MONEY

The battle against bread mold, bane of bakers and housewives for centuries, is being won by science. Dr. William H. Cathcart, 34-year-old head of the A & P national bakery laboratories, has adapted the megatherm, a high-frequency heating unit, to de-mold bread as it takes a five-second "ride" in its wrapper through a special oven. The floor and ceiling of the oven are electrodes, and bread run between the two plates is subjected to dielectric action which kills the mold spores without affecting the taste, texture, or quality of the loaves. This discovery is expected to save more than 150,000,000 pounds of bread and $100,000,000 annually.

Dr. Cathcart (left) inspects the power unit of a megatherm with which he has developed a method of killing mold spores in bread.



The untreated loaf of brown bread (left, below) began to mold three days after baking. Alongside it, an electronically treated loaf, free from mold, is three weeks old.

Dr. Cathcart also perfected an electronic oven to cut the thawing time for frozen foods to minutes and hours instead of days and weeks. Above, a three-pound sample of solidly frozen peaches rests between oven electrodes. In 11 seconds (below) the peaches are ready to be eaten.

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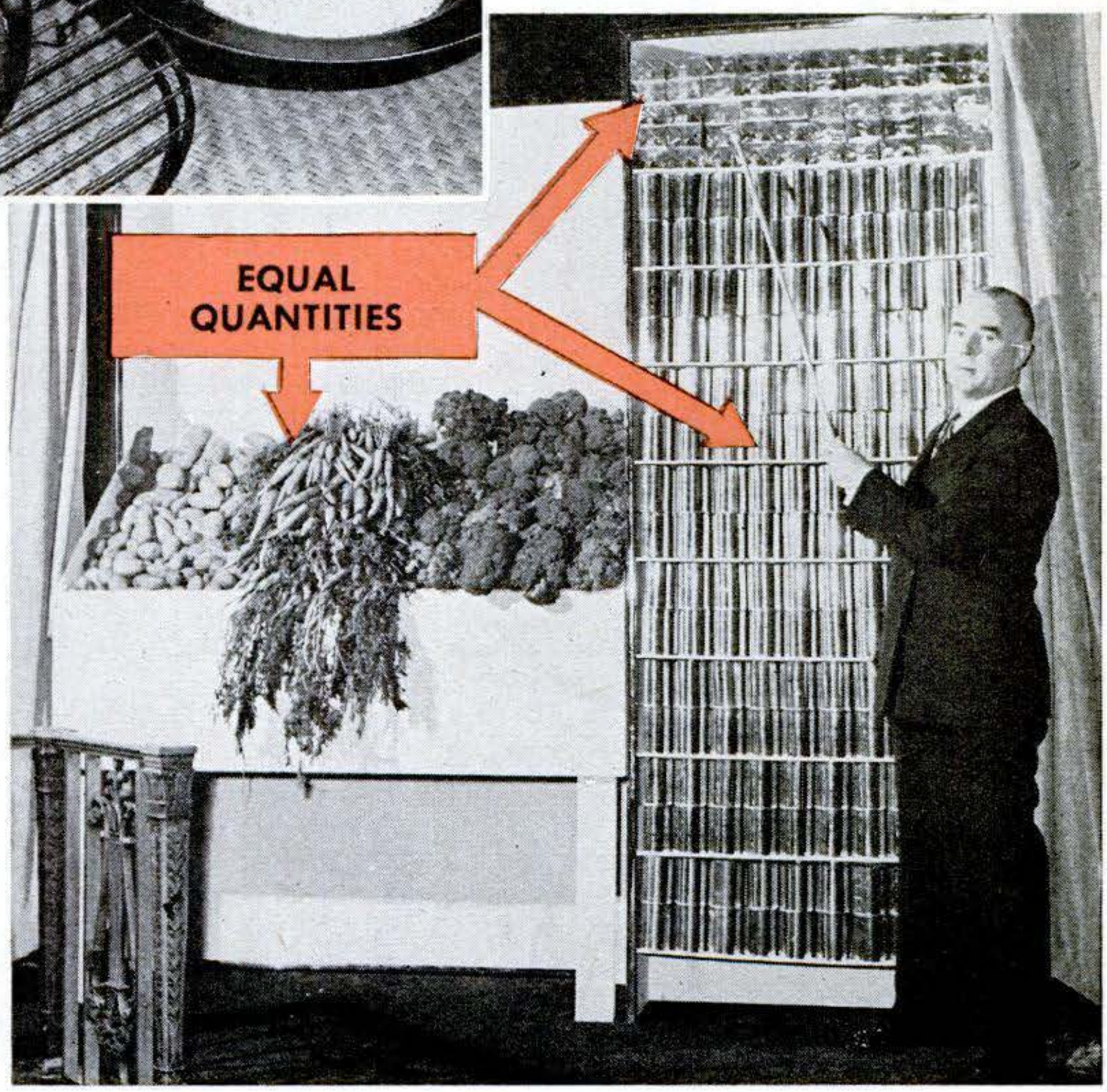
Fluffy mashed potatoes (left) that filled a double boiler were prepared in exactly four minutes by adding boiling water to the same amount of anhydrous riced potatoes as on plate beside it, and stirring.

Two small shelves (below) of packaged anhydrous vegetables hold as much as a large bin of produce or eight very deep shelves of canned goods would contain.



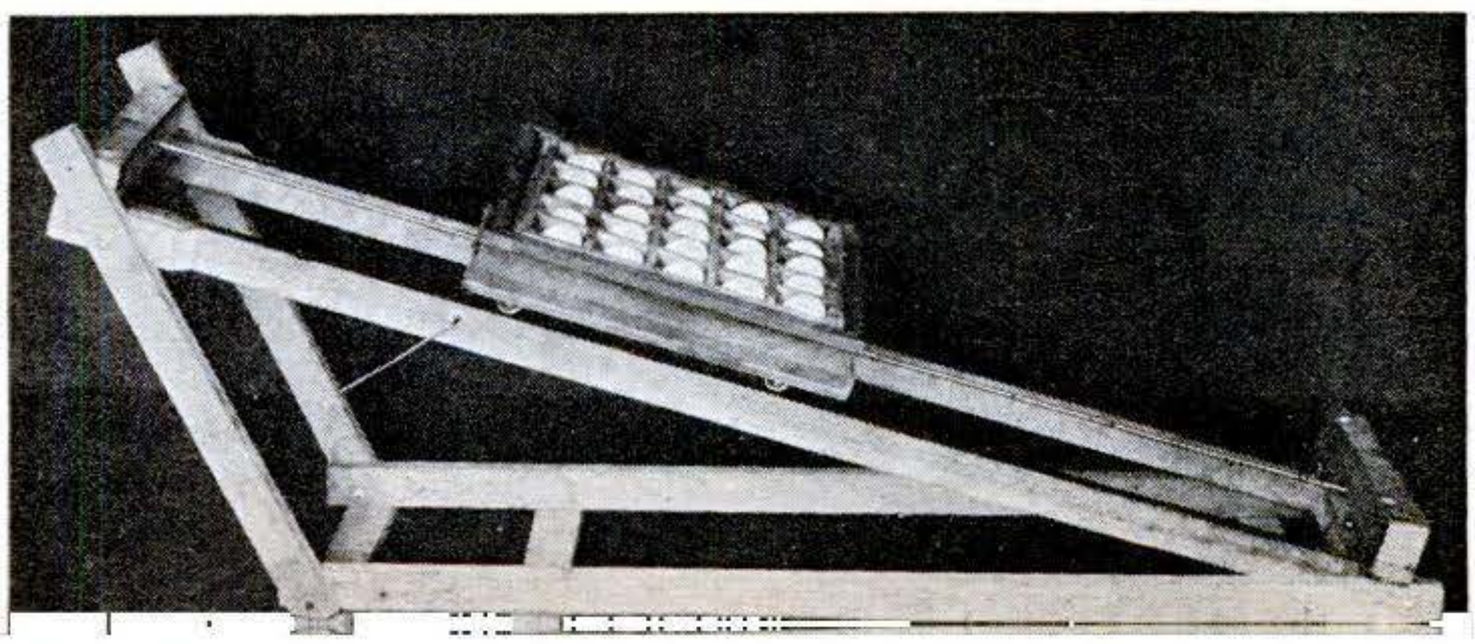
ADD WATER, AND DINNER IS READY!

Family-size, cooked servings of fruits and vegetables, which taste and smell natural, now can be prepared in from four to 10 minutes by adding water and applying heat to substances that, in some instances, look like soap powder.

They are "anhydrous" foods, a new invention of Clarence Birdseye, who originated quick freezing. The secret of their processing, Mr. Birdseye says, is the speed with which water is extracted from them. Potatoes, beans, peas, corn, beets, apples, peaches, berries, or almost any vegetable or fruit that is served cooked, can be anhydrated in about 90 minutes, the inventor reveals, whereas ordinary drying processes average 18 hours. The foods are semi-cooked in his drying process.

"The water is extracted so rapidly, without overheating, that the product does not have time to change its characteristics," Mr. Birdseye declares. "Because of this swift anhydrating action, little time is required to restore the water content in the cooking process."

To demonstrate, Mr. Birdseye emptied anhydrous riced potatoes into the top of a double boiler, stirred them in boiling water and beat them until they were fluffy. It took four minutes. American Home Foods, Inc., expects to have many anhydrous products on grocers' shelves early next year.



SHELL SHOCK is given eggs on this incline at Ohio's Agricultural Experiment Station to determine if they are strong enough to go to market. They ride, small end down, in a tray on casters. When it hits bottom, shells below standard strength crack, but don't break.

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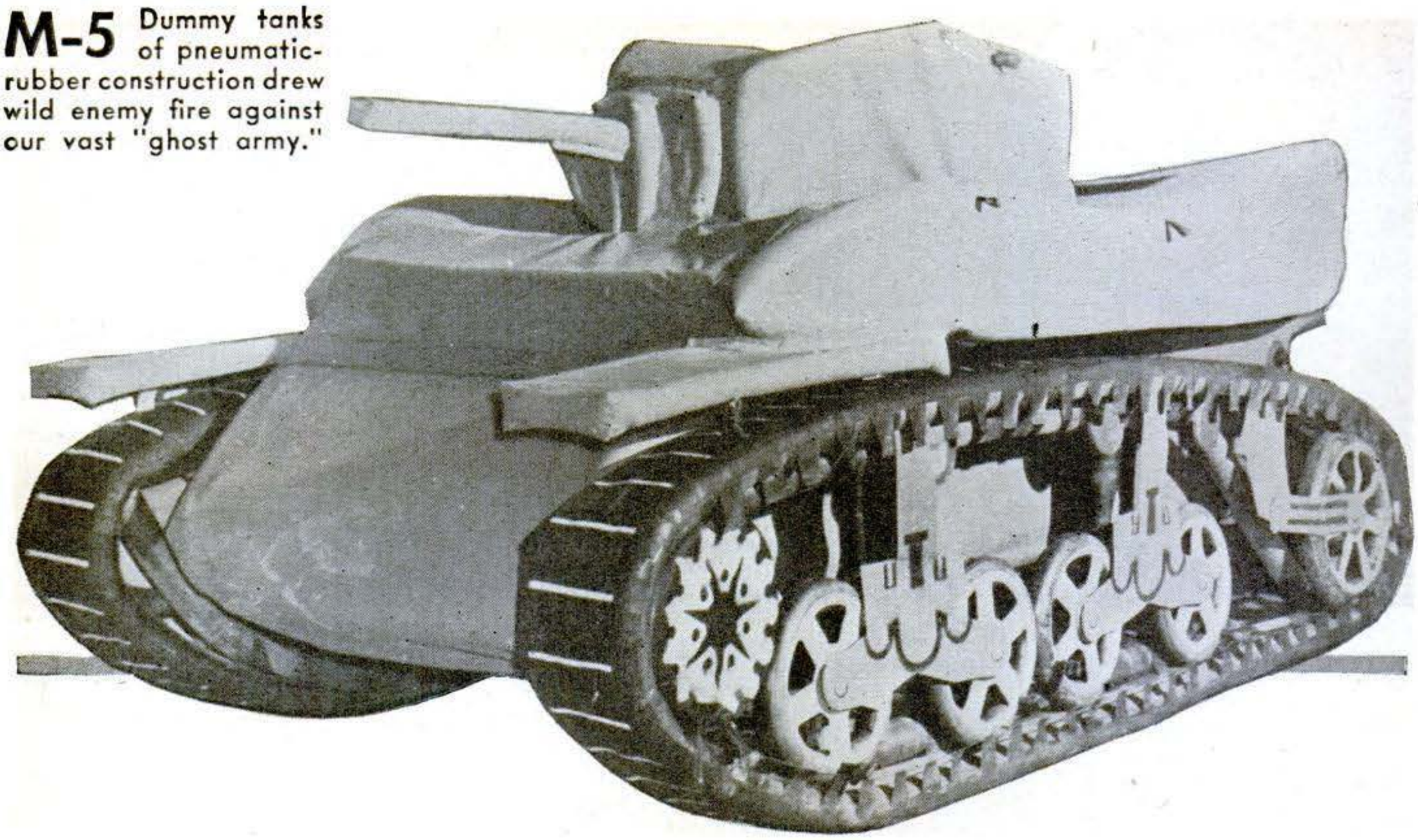


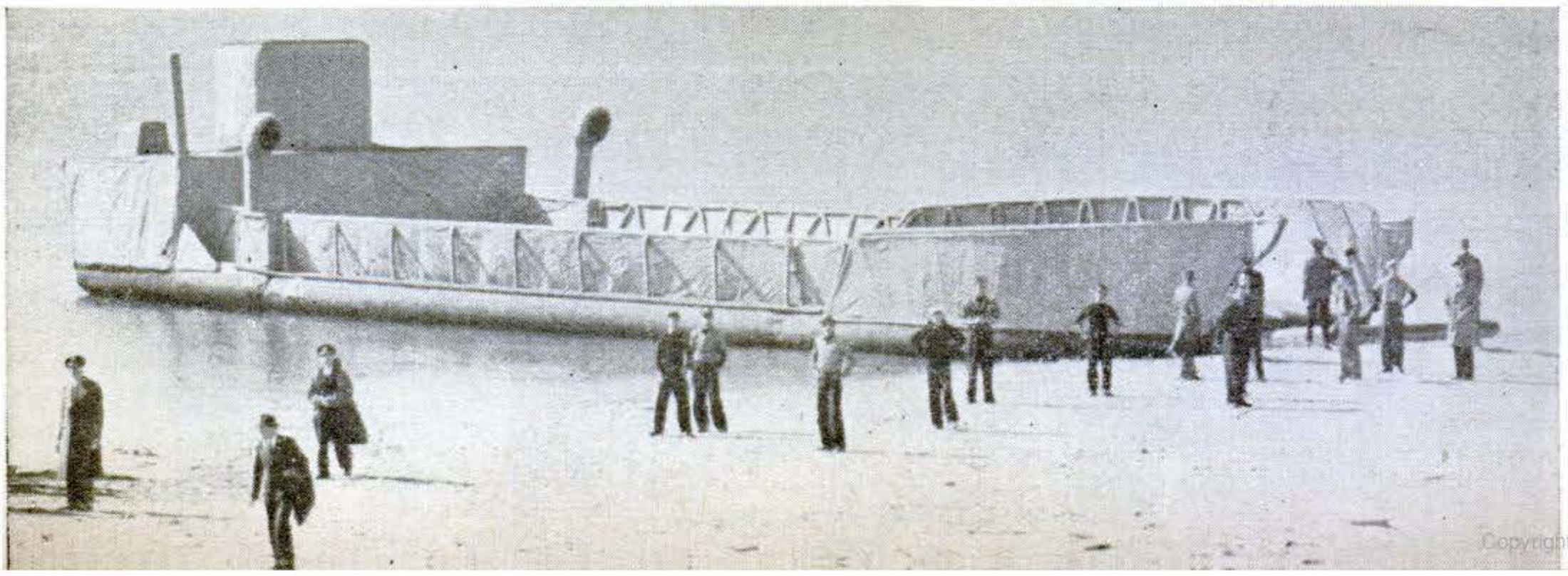
M-5 Dummy tanks of pneumatic-rubber construction drew wild enemy fire against our vast "ghost army."

Decoy Army Fooled Nazi Master Minds

LANDING craft, tanks, trucks, antiaircraft and antitank guns, and various other field artillery pieces, blown up with compressed air like gigantic Tony Sarg figures to represent large convoys and emplacements, made up an American "ghost army" that completely fooled the Nazis and played a highly strategic role in European operations. Enemy reconnaissance many times saw "loaded fleets" in British ports and large-size mechanized units in the fields, which in reality were only decoys made to resemble 19 different weapons and pieces of equipment used by our forces. The true nature of these decoys was undetectable even within a few hundred yards.

Manufacturers of lace, theatrical equipment, and tires aided in the production of the balloon-fabric, full-scale models. From the air or on the ground, the pneumatic copies had the same bulk and silhouette as the real thing.

LCT Fleets of these weapon-carrying craft appeared and disappeared overnight in invasion harbors along the English Channel to confuse the Germans in the days preceding D Day. Right, an inflatable decoy LCT begins to take shape; below, it is launched. Many of them could stand up for 10 days without repairs.



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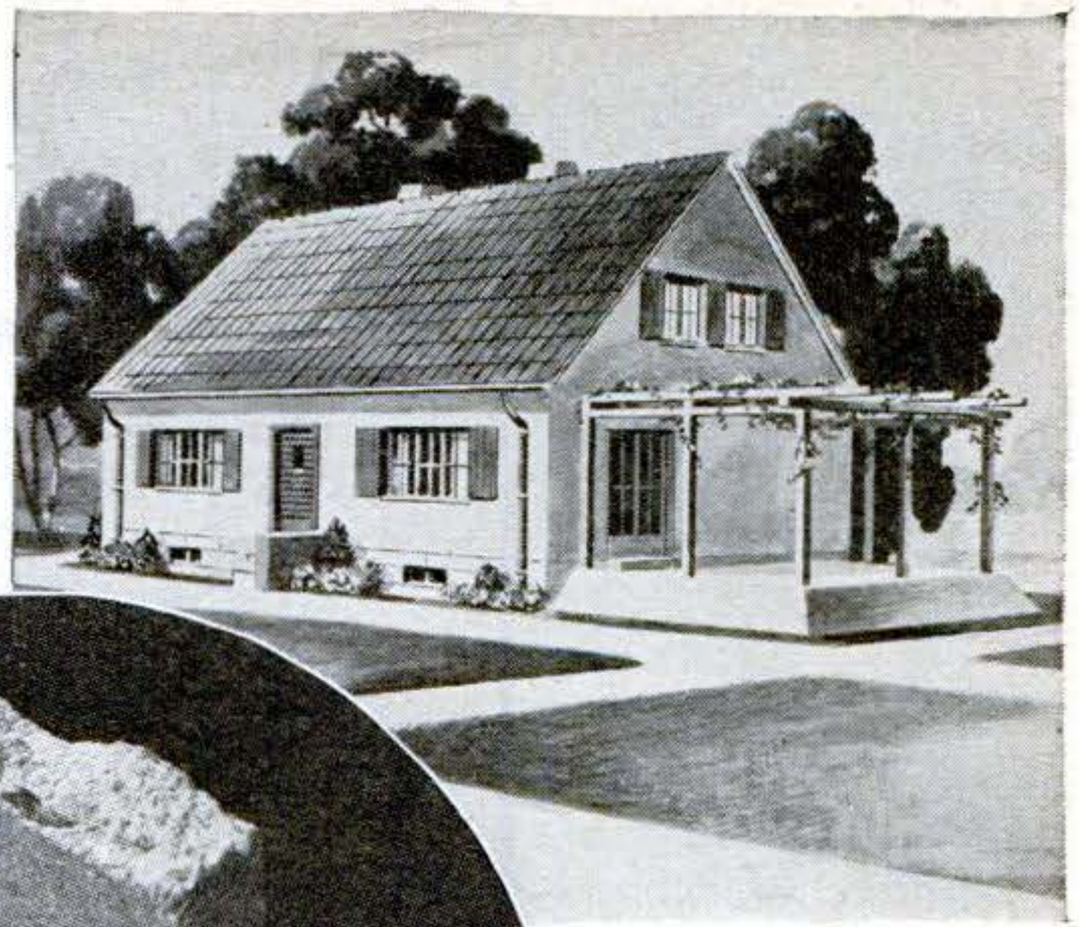

This five-room cottage has been designed to be built of strong rubble brick. The hand (left) holds a roofing tile of same material.

RUBBLE to rebuild GERMANY

Prof. Reutlinger's vibrating "table," which shakes molds of ground-up debris and cement into bricks of adequate strength, and his 65-hour curing process may overcome seemingly hopeless shortages of materials, of coal, and of skilled workers.

By CARL LEVIN

(USFET Press, Frankfurt, Germany)

and HARTLEY E. HOWE

IF THE trains, and the coal to run them, and a dumping place for the rubble were all available, which they aren't, it would take ten 50-car trains a day to clear away the ruins of Berlin. It would also take 16 years. In the meantime, all the inhabitants would have to worry about is how to rebuild in the face of shortages which leave no coal for kilns, no steel for beams, and few skilled workers. The prospects of reconstruction would be black indeed—if it were not for the timely appearance of Professor Reutlinger and his vibrating table.

George Reutlinger is a widely-known physicist and vibration engineer. From his workshop in bomb-flattened Darmstadt, near Frankfurt, Reutlinger has produced a machine and a process which he claims will: (1) solve the clearance problem by processing the rubble in the vicinity; (2) simultaneously provide the materials for rebuilding by turning the rubble into bricks and blocks of unusual strength in three or four days; (3) enable unskilled labor to do the building; (4) use a minimum of fuel and power; and (5) provide buildings which require a minimum of steel.

This is a large order. If the professor is right, German communities may be able to house the civilians now living in the ruins. Cities may rise from their rubble like the mythical phoenix that was periodically reborn from its own ashes. To do the job, Reutlinger uses a table—a shaking table, which compacts the ingredients into usable blocks and bricks.

This shake-up is declared to be the answer to the old problem of combining ultimate strength with ability to flow. The best—strongest—cement mix is one made with a

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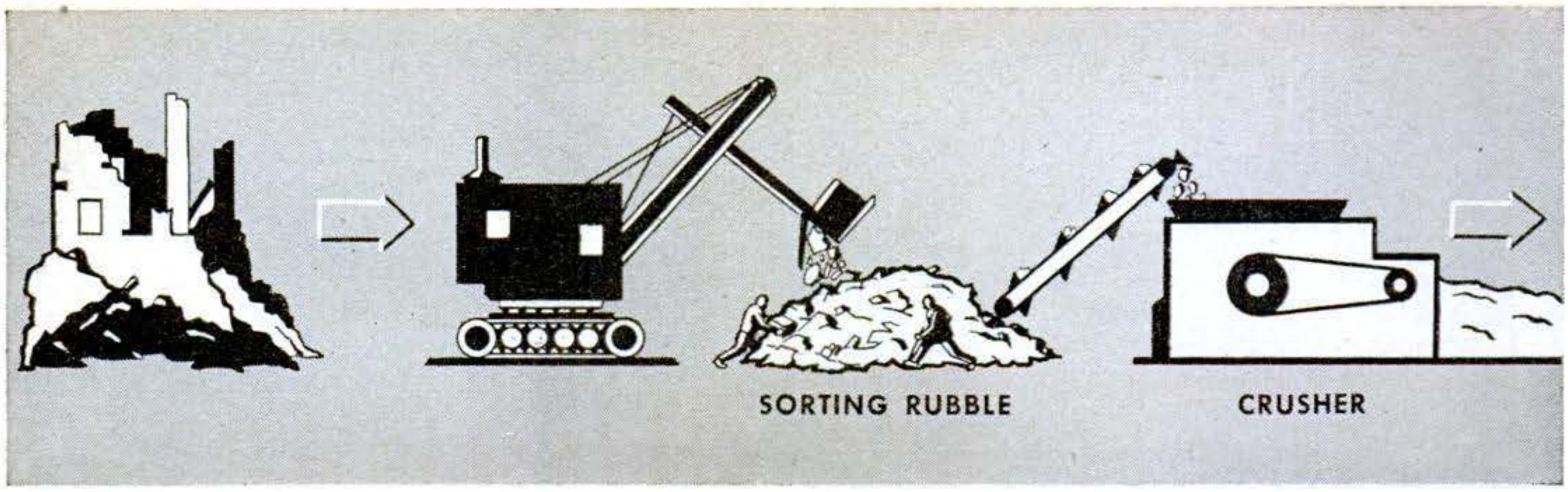


minimum of water. Unfortunately, this mix is too thick to flow properly into a mold. Professor Reutlinger declares his vibration table will make a mixture capable of being formed, enabling the use of a comparatively dry mix to produce a block of adequate strength.

Before it reaches the vibration table, however, the rubble must be processed. First, it is sorted to remove wood, metal, cloth, or organic matter which would be unsuitable for brick making. What is left—bricks, mortar, stone, plaster, cement, concrete, and so forth—is then ground to fragments the size of a walnut or smaller. These are screened into three sizes which are then combined in fixed proportions in a mixer mounted on a vertical oscillator. The resulting blend is fed into a standard cement mixer and one part of cement is added for every 12 or 15 parts of rubble—and Germany has plenty of cement. As the rubble and cement revolve in the mixer, enough water is added to give the mix a consistency very little wetter than that of garden earth. It is then poured into special molds.

Here is where the vibration table comes in. The molds are placed on the table—a platform geared to electric motors which shake it simultaneously from side to side and up and down—and are given a 30-second workout. A mechanical arm meanwhile forces the mold cover down, compressing the bricks at the same time the vibrations shake their component particles together.

Five or six hours after removal from the table the mixture has set and the blocks can be removed from the forms. They are then given a final cure in a room kept at a temperature between 90 and 108 degrees Fahrenheit by steam heat. This process, which Professor Reutlinger calls "climatization," takes about 65 hours and is said to require less than half the coal or current needed for the standard brick kiln.

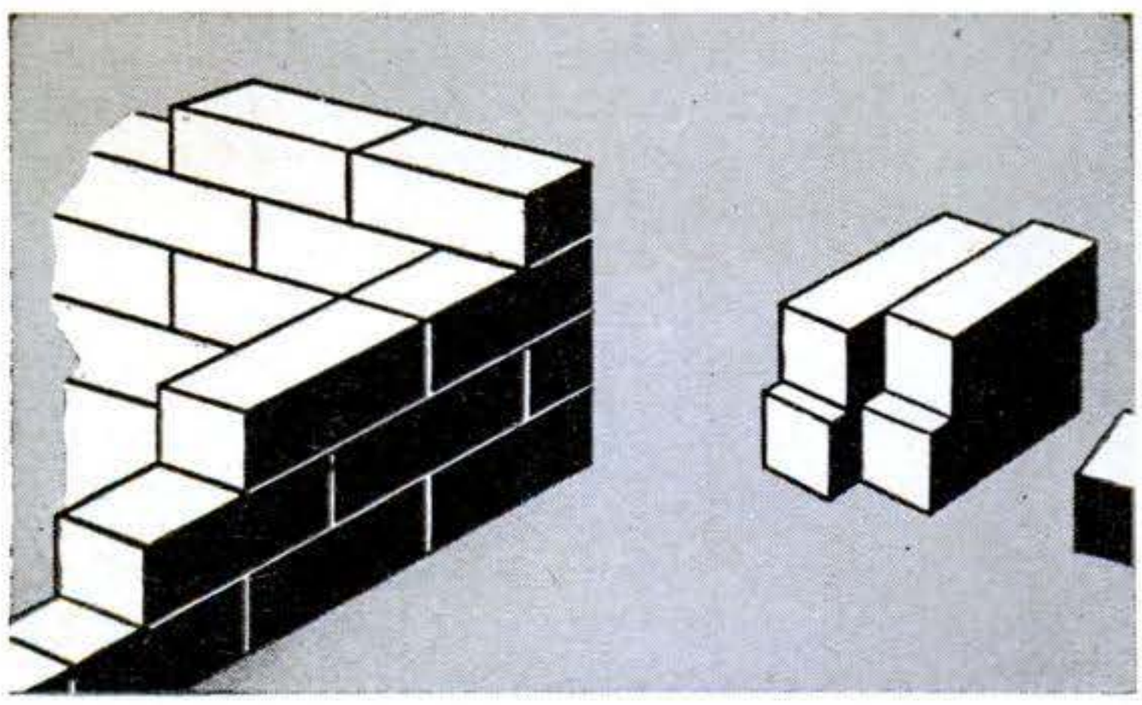
The final product, now ready for use, is a gray brick or building block. In addition to its strength it differs from the more brittle, mold-poured, conventional cement block in that it does not retain moisture.

By changing the proportions of the mix to 10 parts of rubble to one of cement and hiking up the pressure on the mold by 40 percent, roofing tiles can be turned out by the same process. Reutlinger asserts that these tiles, which will take a smooth coat of paint in any desired color, are the ideal roofing material—and that he can turn out all Germany will need to roof her houses.

To make it easier for amateur bricklayers, bricks have been designed with interlocking shapes. By using these along with prefabricated parts cast from the rubble mixture, unskilled labor should be able to build a house in a few days.

A rubble cottage has been designed. It has five bedrooms, living room, work room, bath, kitchen, and cellar—but it is not as luxurious as it sounds, since four of the bedrooms are compressed into a half story under the roof.

Reutlinger declares that his vibration system can be used not only to manufacture wall materials but also to make the supporting girders. In this case, one part of cement is mixed with three parts of gravel, poured into long girder-shape molds, reinforced with strands of piano wire, and shaken well. Such girders have the added asset of requiring a minimum of steel at a time when the Allies are planning to make



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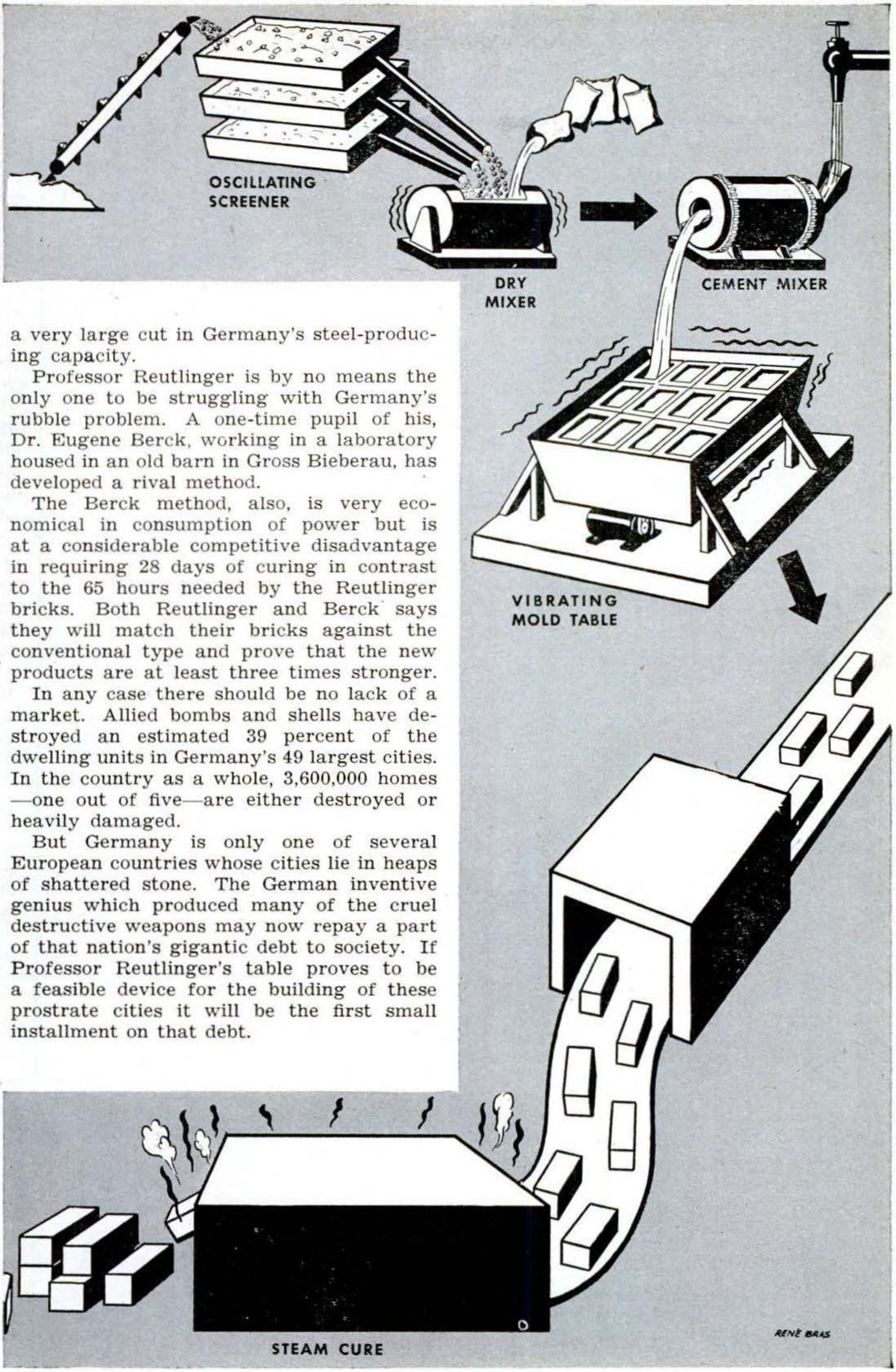

a very large cut in Germany's steel-producing capacity.

Professor Reutlinger is by no means the only one to be struggling with Germany's rubble problem. A one-time pupil of his, Dr. Eugene Berck, working in a laboratory housed in an old barn in Gross Bieberau, has developed a rival method.

The Berck method, also, is very economical in consumption of power but is at a considerable competitive disadvantage in requiring 28 days of curing in contrast to the 65 hours needed by the Reutlinger bricks. Both Reutlinger and Berck says they will match their bricks against the conventional type and prove that the new products are at least three times stronger.

In any case there should be no lack of a market. Allied bombs and shells have destroyed an estimated 39 percent of the dwelling units in Germany's 49 largest cities. In the country as a whole, 3,600,000 homes —one out of five—are either destroyed or heavily damaged.

But Germany is only one of several European countries whose cities lie in heaps of shattered stone. The German inventive genius which produced many of the cruel destructive weapons may now repay a part of that nation's gigantic debt to society. If Professor Reutlinger's table proves to be a feasible device for the building of these prostrate cities it will be the first small installment on that debt.

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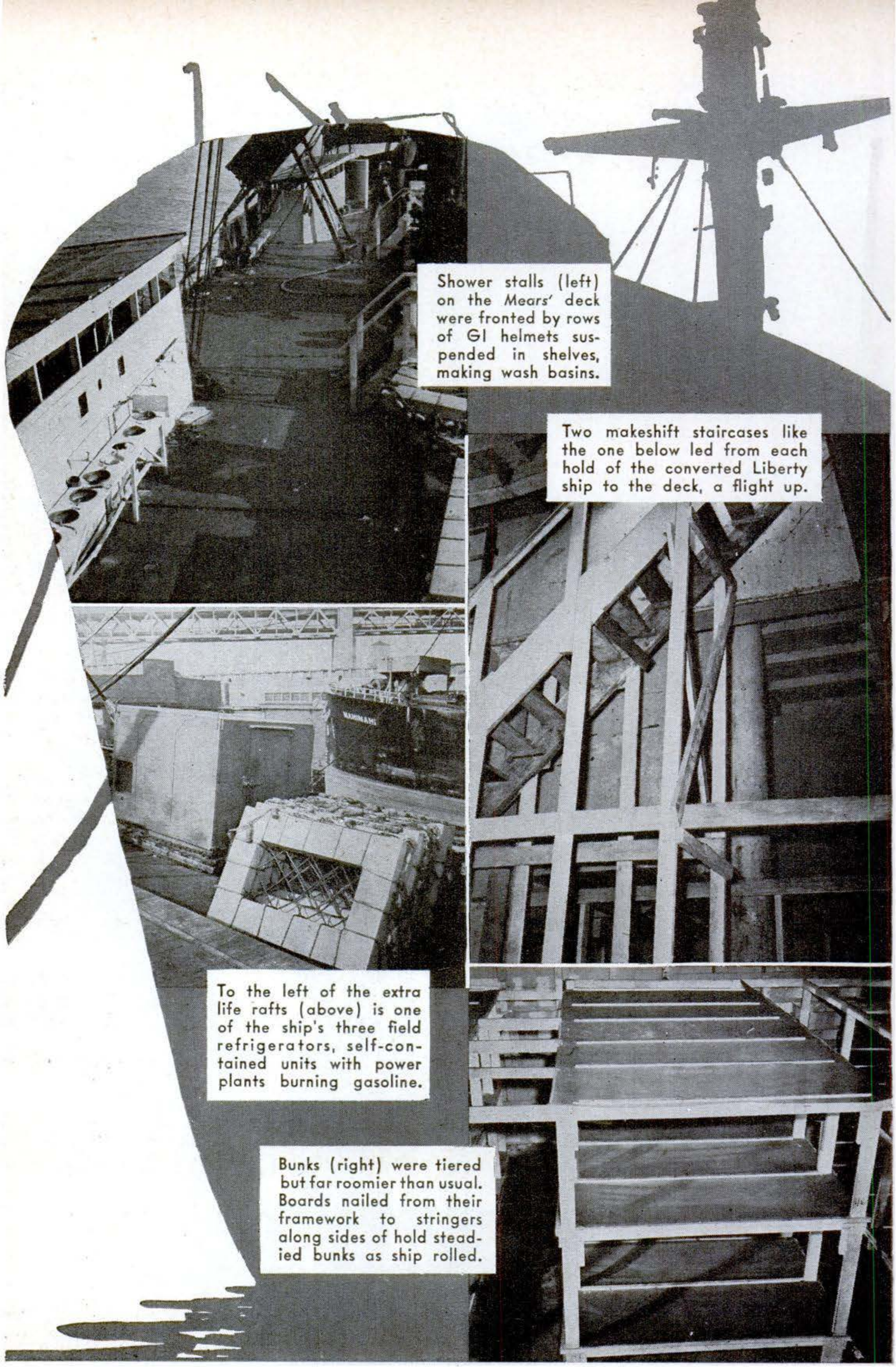

Shower stalls (left) on the *Mears'* deck were fronted by rows of GI helmets suspended in shelves, making wash basins.

Two makeshift staircases like the one below led from each hold of the converted Liberty ship to the deck, a flight up.

To the left of the extra life rafts (above) is one of the ship's three field refrigerators, self-contained units with power plants burning gasoline.

Bunks (right) were tiered but far roomier than usual. Boards nailed from their framework to stringers along sides of hold steadied bunks as ship rolled.

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GI's BUILD *own* TRANSPORT

"Give me 50 men and 48 hours," the colonel said—Four days later 534 men started home.

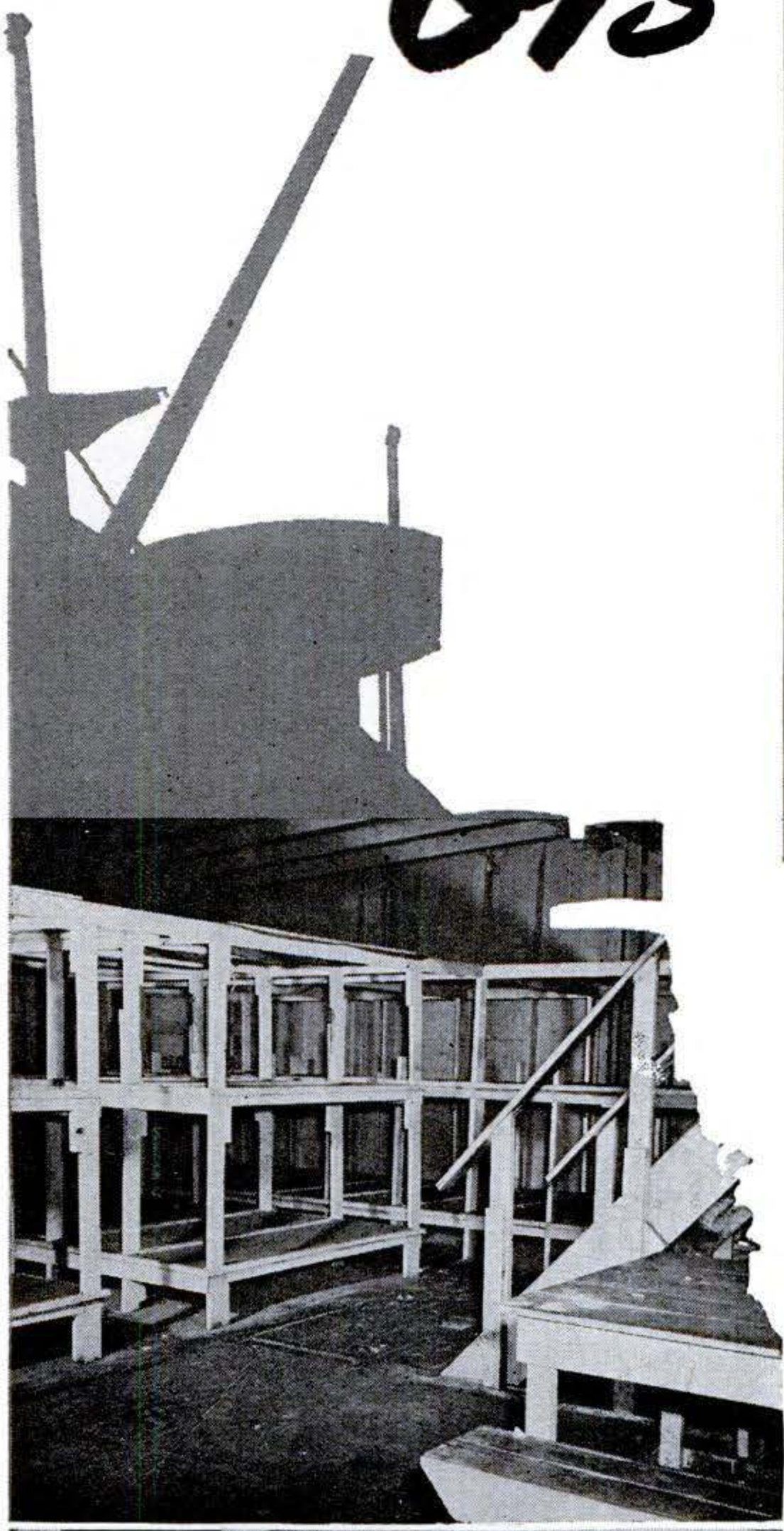
By Larry McManus

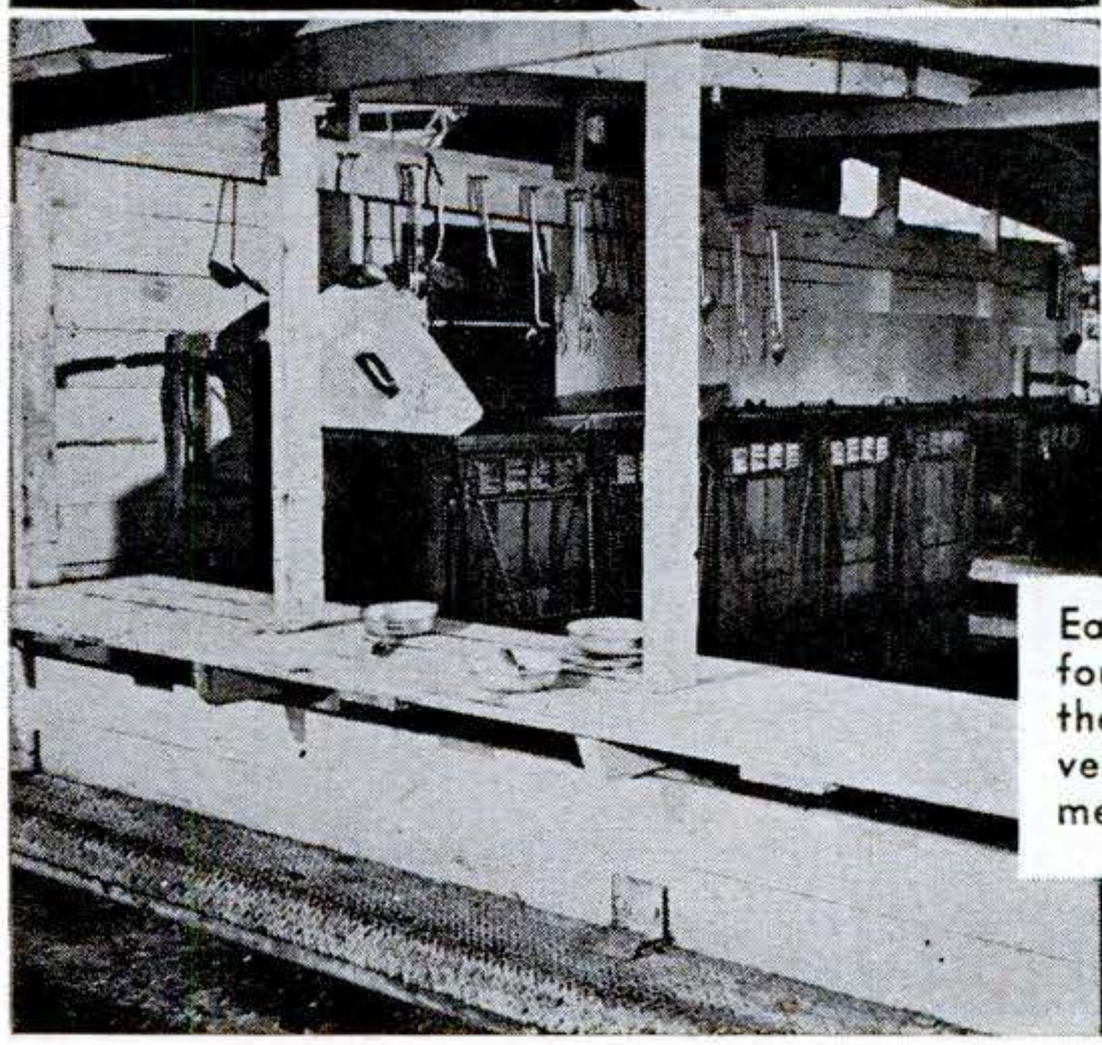
BLUNT-NOSED, boxlike Liberty ships designed exclusively for carrying cargo are returning thousands of high-point veterans to the United States despite dark predictions by "experts" that it was impossible.

An admiral once testified before a Senate committee that it would take two months and $250,000 to convert a Liberty into a troopship. A general in Washington said that no more conversions of cargo ships were being ordered because the shipping crisis would be over before they could be completed. A shipyard manager in Portland, Oregon, declared conversion would cost even more than the admiral had estimated.

But these dire forecasts of difficulty failed to deter the attempt of soldiers in Manila to obtain and convert a ship to see if it could be done.

Thousands of soldiers had been waiting in





Each hold of the *Mears* in which GIs slept was allotted four tables, with two benches each. One shows in the top picture at left. The bottom photograph reveals part of the galley shack on deck, where three meals a day were cooked on Army field ranges.

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Manila's crowded shipping depots for weeks, awaiting transportation home after many months overseas. They could see a harbor full of ships, many of them scheduled to return to the United States virtually in ballast. Huge piles of surplus lumber lay in near-by government storage areas. Most important of all, the men themselves were driven by an intense desire to return home—a factor the "experts" in the United States failed to consider.

Letters began to pour in to The Pacifican, an Army newspaper publishd in Manila. "We went into combat aboard cargo ships; why can't we go home in them?" most of the letters asked.

"Not enough water available—fire hazard—insufficient galley and refrigeration facilities—not enough lifeboats—no sick-bay—" were some of the answers they got.

The situation was stalemated until a capable, experienced Army officer, Lt. Col. C. H. Davidson, came to the soldiers' aid with a statement which rocked Western Pacific service circles almost as sharply as news of Japan's surrender.

"Give me 50 men," he told a Pacifican reporter, "and in 48 hours we'll convert a Liberty into a troopship that will pass any inspection."

Complaints from homesick soldiers could be brushed off, but not the statement from Davidson, whose experience included making all shipping arrangements for moving two entire Army divisions from Australia to New Guinea and other islands.

Skeptical authorization was given, and a note was posted on the bulletin board of the 821st Aviation Engineers asking for volunteers to help try to convert the Liberty ship *Otto Mears*. Master Sergeant Doyle L. Smith chose 70 from among hundreds of volunteers, many of whom had been overseas for more than 40 months.

All had put in a full day's hard labor on a Luzon road construction job, but at 6 p.m.—on their own free time—they filed aboard ship with welding equipment, electrical supplies, carpenters' tools, pipe and lumber.

Four days later, the *Mears* left Manila with 534 soldiers aboard, and, 24 days after that, sailed through the Golden Gate.

"A much better ship than the one we went over on," said Sergeant James J. Smith of the 978th Signal Company, voicing the unanimous passenger opinion. "The best trip we ever had as far as comfort was concerned."

Instead of the usual cramped bunks on most transports, the *Mears* offered large canvas three-deckers amply spaced on frames of 2 x 4 scrap.

Instead of living deep in the hold, all the *Mears'* passengers were just one flight down a makeshift staircase from the fresh air above.

Instead of the usual two meals daily, three well-balanced meals were served each day from a galley erected on the forward deck.

The galley—or rather "field kitchen," since it was an Army operation—contained nine GI field ranges heated by gasoline from a score of 55-gallon drums lashed to the deck nearby. Food was stored in field refrigerators, each a self-contained unit with its own built-in power plant using gasoline as fuel.

Extra life rafts studded the decks and each man had a life belt.

Holds Number 1, 4, and 5 contained 150 to 200 each of the triple-decked bunks while Number 3 was set aside for officers, the popular Post Exchange—a feature rarely found on transports—and the dispensary where a full medical staff held sick call at 8 a.m. daily.

Officers, incidentally, slept on regulation Army cots but bucked the chowline impartially with their men.

Hold Number 2 added the de luxe touch to the *Mears*, for it contained facilities not found on even the largest of transports. It was turned into a spacious, airy recreation room complete with books, games, phonograph, radio, writing tables, ping-pong equipment and movies every night.

Shower shacks were constructed on each side of the deck, aft of the superstructure, with the traditional washstands of GI helmets suspended in holed planks. Farther aft were two latrines where streams of salt water rushed through the makeshift plumbing in a manner that effectively met strict Army sanitary regulations. All these shacks on deck were secured by bolts to angle irons welded to the deck plates.

"And water was no problem at all," a ship's officer said. "We had enough to let the men take fresh water showers the last few days."

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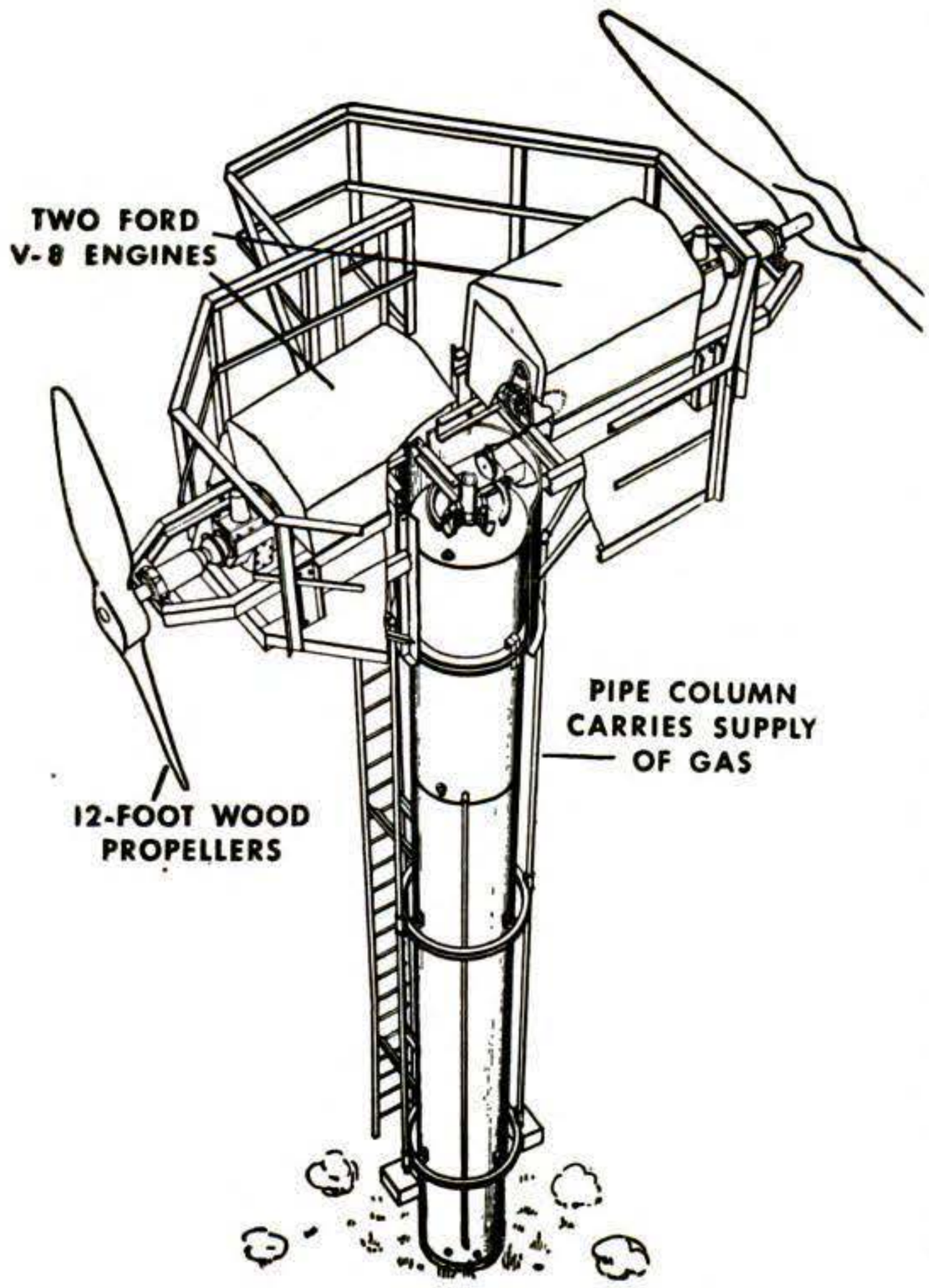
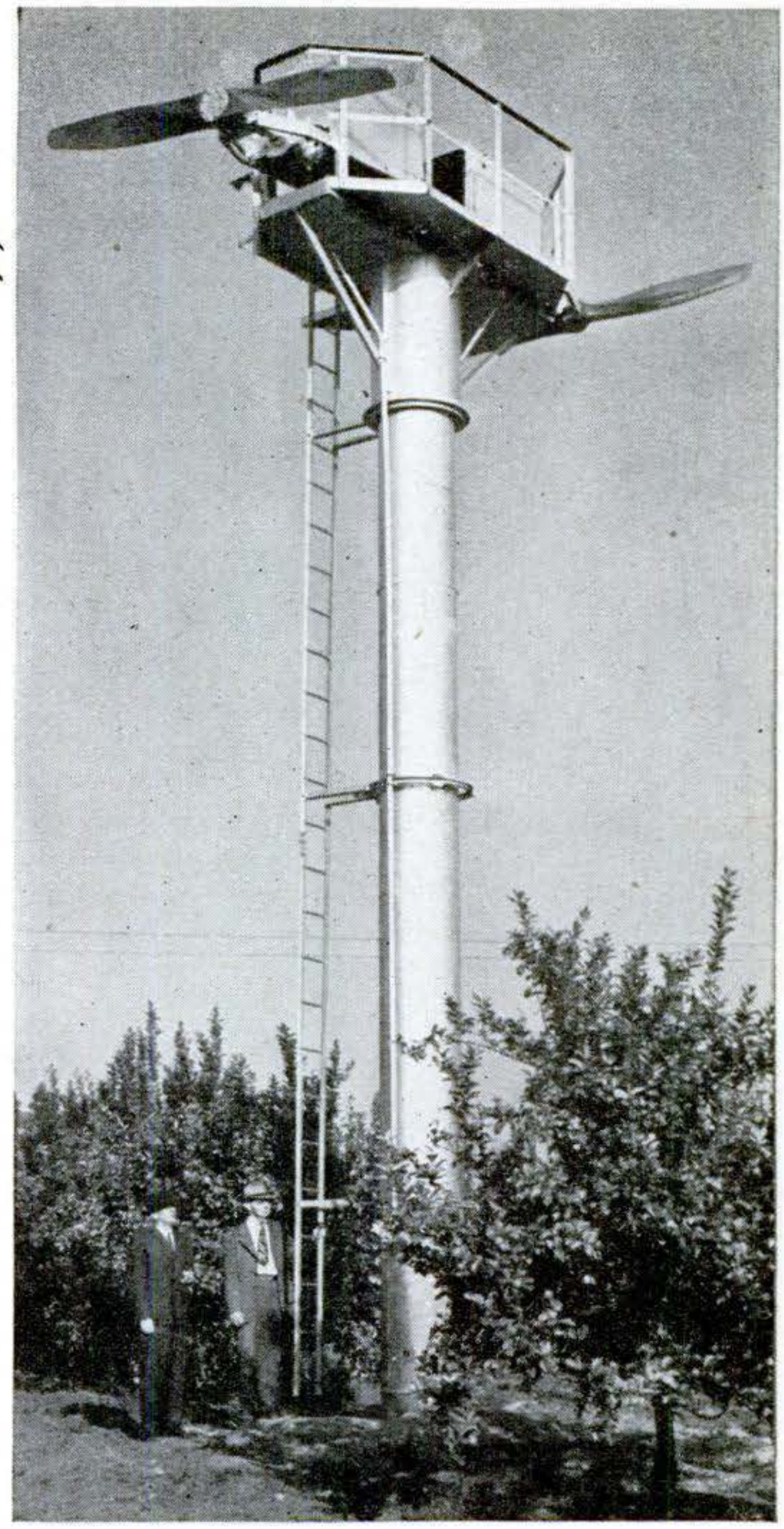


This diagram shows a treetop view of the two-way revolving fan that dispels frost in fruit orchards.

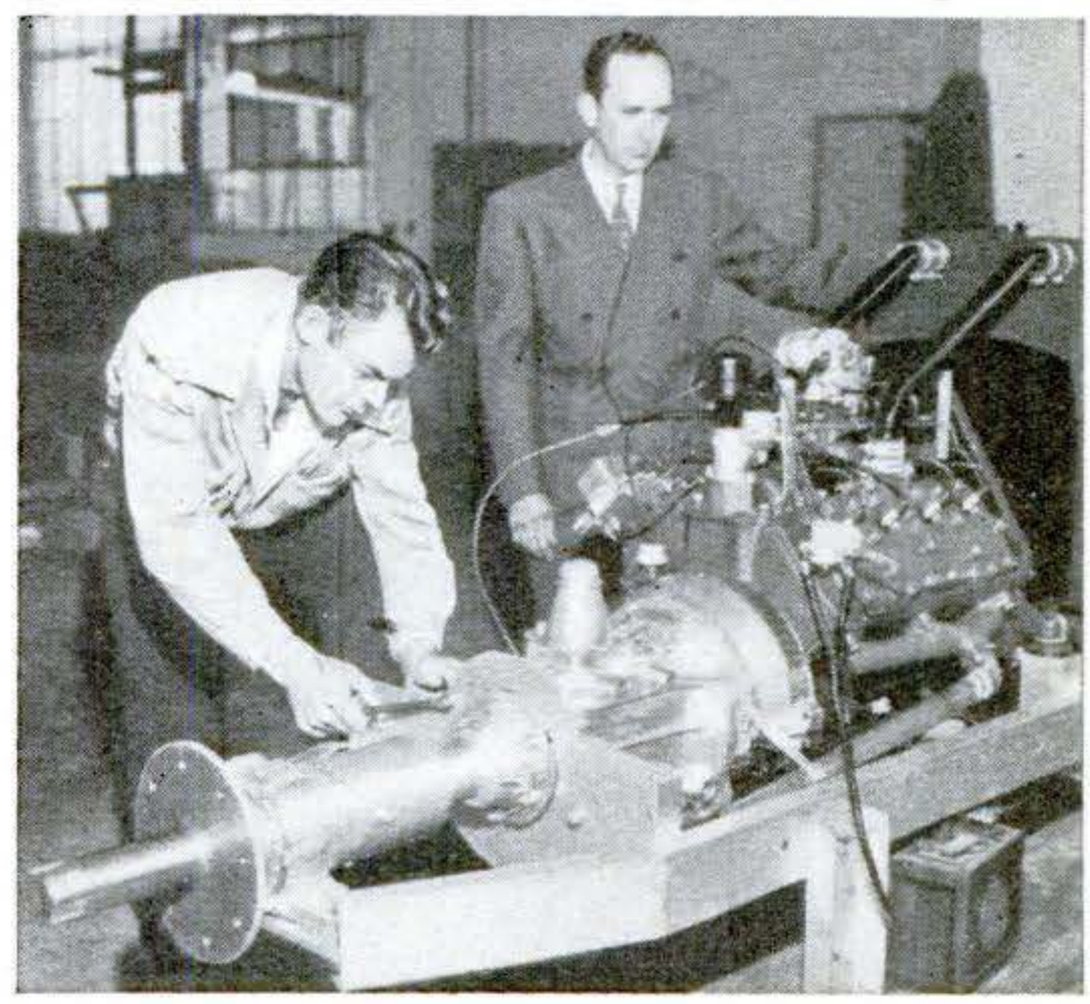
NEW WIND MACHINE BLOWS FROST AWAY FROM CITRUS FRUITS

ON CALIFORNIA nights when occasional freezes threaten the crops, thousands of acres of citrus and deciduous fruits are protected from frost by moving air. The air is driven continuously by revolving wind machines carrying their own gasoline supplies in the pipe columns on which they turn. The breeze forces warm air from above to mix with the colder ground air, and this raises the temperature around the trees. One such double wind machine is declared to do as effective job of protection as 1,000 smudge pots. Two Ford V-8 engines drive the 12-foot wood propellers at 950 r.p.m. Power take-offs from the engines revolve the entire head, including the platform and ladder leading to the ground, once every nine minutes. The 26-foot column contains 640 gallons of gas, enough for a stretch of 40 hours. One pair of engines moves 632,000 cubic feet of air a minute at 30 m.p.h. The machine is manufactured by the National Frost Protection Co., Glendale, Calif.



One wind machine like this replaces 1,000 smudge pots, and wards off frost from 20 acres of trees.

Modifying a Ford V-8 engine to permit fitting one of the propellers that make the frost-killing wind.



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It's wonderful what you can make out of sea shells, particularly if a pretty Wave will work beside you.

USO Backs PSM Contest

OFFERS TOOLS, MATERIALS TO GIs SEEKING $3,300 PRIZES

THE USO, in a typically warmhearted gesture prompted by the celebration of its fifth anniversary, has placed the workshop facilities of its thousands of clubs in this country and overseas at the disposal of servicemen and women who want to submit entries in the GI Handicraft Contest sponsored by POPULAR SCIENCE MONTHLY. This gives them a chance to make a possible prize-winning entry before the contest closes at 6 p.m., Monday, April 1. There is still plenty of time to have a try at the $3,300 in prizes, which run from 50 awards of $25 each to a fat first prize of $1,000.

Leather, plexiglas, sea shells, copper, wood, and alloy metals are among the materials provided at USO clubs. They are supplemented by special purchases or by other souvenir materials the contestants may bring in.

Simple tools available often are gifts from well-equipped home workshops in the neighborhood. Manufacturers lend band saws, drill presses, and other equipment usually not within reach of amateur handicraftsmen. Here is a boon to contest entrants who may not have access to tools.

Posters invite USO visitors to enter our contest and you can obtain official copies of the rules at the USO on request. Otherwise, write to Servicemen's Handicraft Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Ave., New York 10, N. Y., for your copy.

The most important rules are worth repeating:

Men and women now in service, veterans who have received honorable discharges since Dec. 7, 1941, and merchant seamen who served during the war are eligible. Veterans and merchant seamen must have completed their contest entries *while in active service.*

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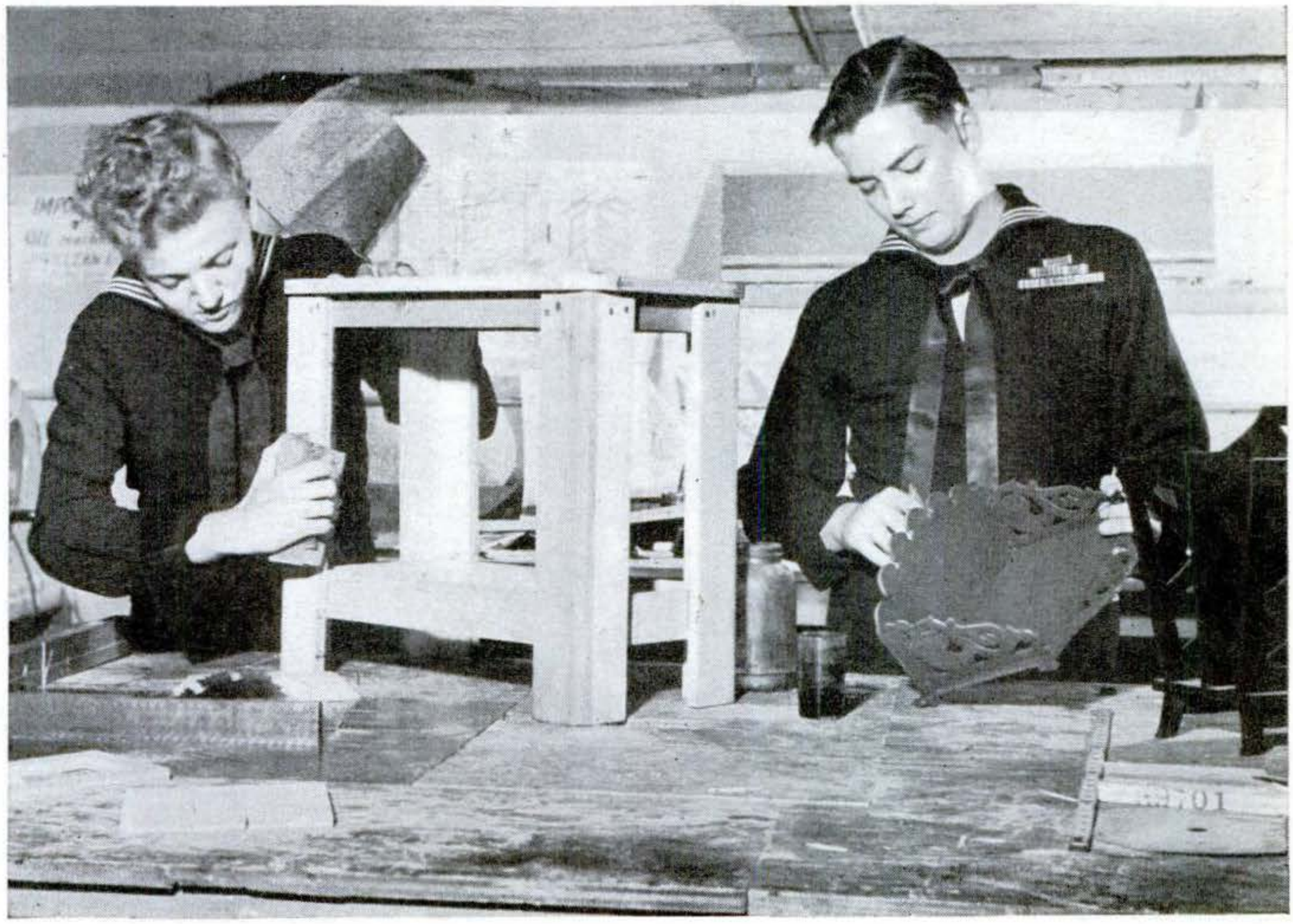
At the Long Beach, L. I., USO club, where all these handicraftsmen were photographed, Wave Elizabeth Price starts work on the cover of a cigarette box.

One done and one to go! Seaman James Bean, of Lido Beach Separation Center, saws legs for an end table to match the completed one on the floor.



A table and a whatnot given finishing touches by Seaman Edward Banker (left) and Seaman Jack O'Brien.

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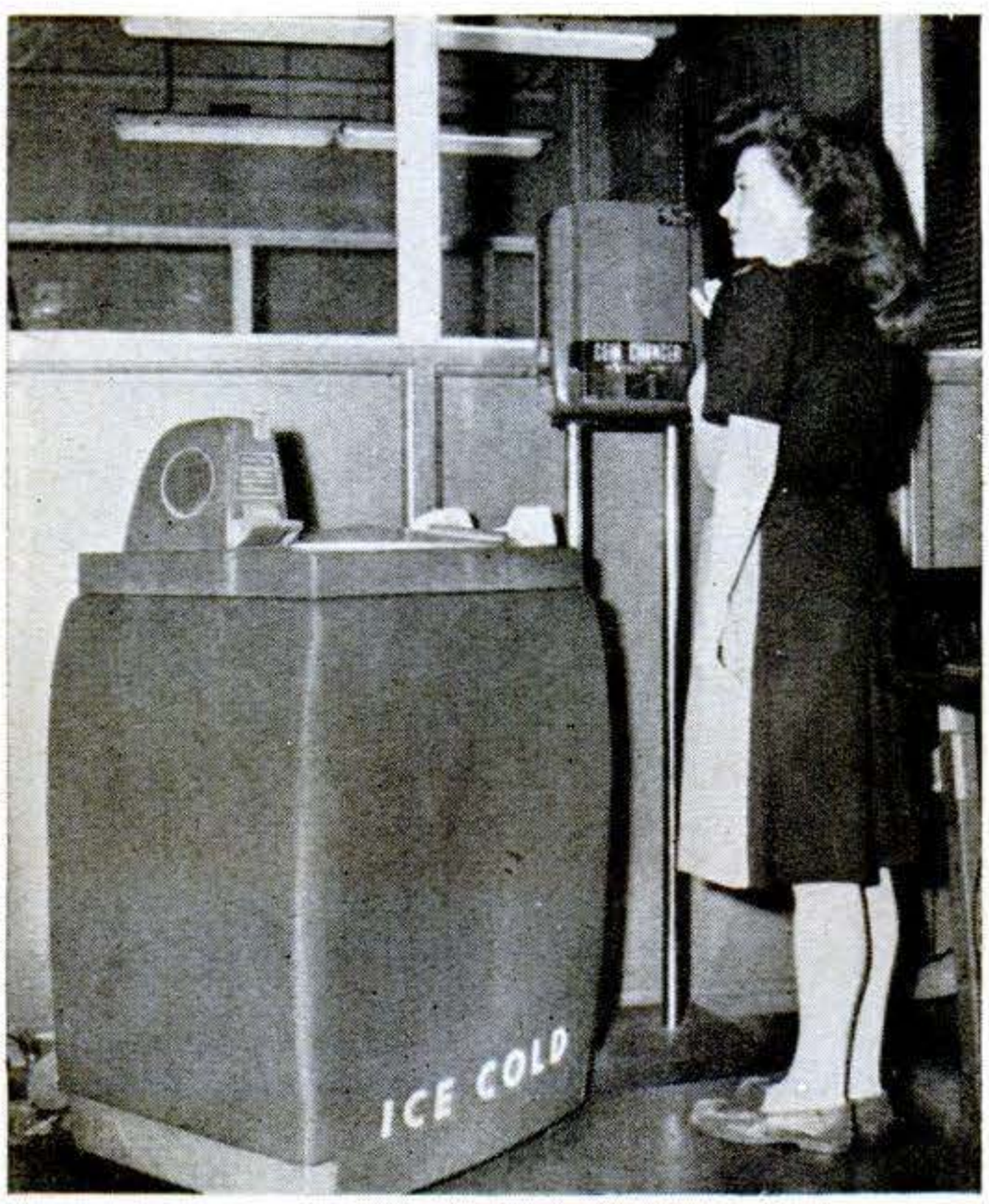
modern living

WATERPROOFED WASH is in prospect for housewives who add a few drops of Socony Vacuum's new Fabrisec Emulsion to the family's laundry. The solution contains paraffin-wax particles, and some of these are deposited on the cloth fibers. Water, poured through a sprayer, rolls right off the treated cloth shown at the left. The emulsion is said to retard soiling and wrinkling without changing the appearance of the fabric.

SISTER, CAN YOU SPARE A DIME? The words haven't changed much, but the tune has. For the Vendo Company's coin-changing machine always has the right answer and the right change. Mary Jeanne Hendrix —who has a dime—demonstrates by dropping it into the slot. The changer gives out the nickels, and the big box gives out soft drinks. In tests lasting over two years, the coin-changer has helped quench a lot of thirsts. It is also expected to keep changeless people happy in phone booths.

TWO PAIRS OF ARMS are pleasingly displayed in the photo above. The more shapely ones are demonstrating a hollow-arm quilted chair at Macy's, New York. It's a new furniture wrinkle for cramped quarters. For keeping magazines, thimbles, cigarettes, and the like right on tap, it has table drawers beat hollow.



SCRUBLESS cleaning is promised by the R. M. Hollingshead Corp., makers of "Whiz-Off." Mixed with warm water, the cleaner is said to remove imbedded dirt and grease by chemical action, thus making scrubbing unnecessary. It is to be used especially as a treatment for floors.

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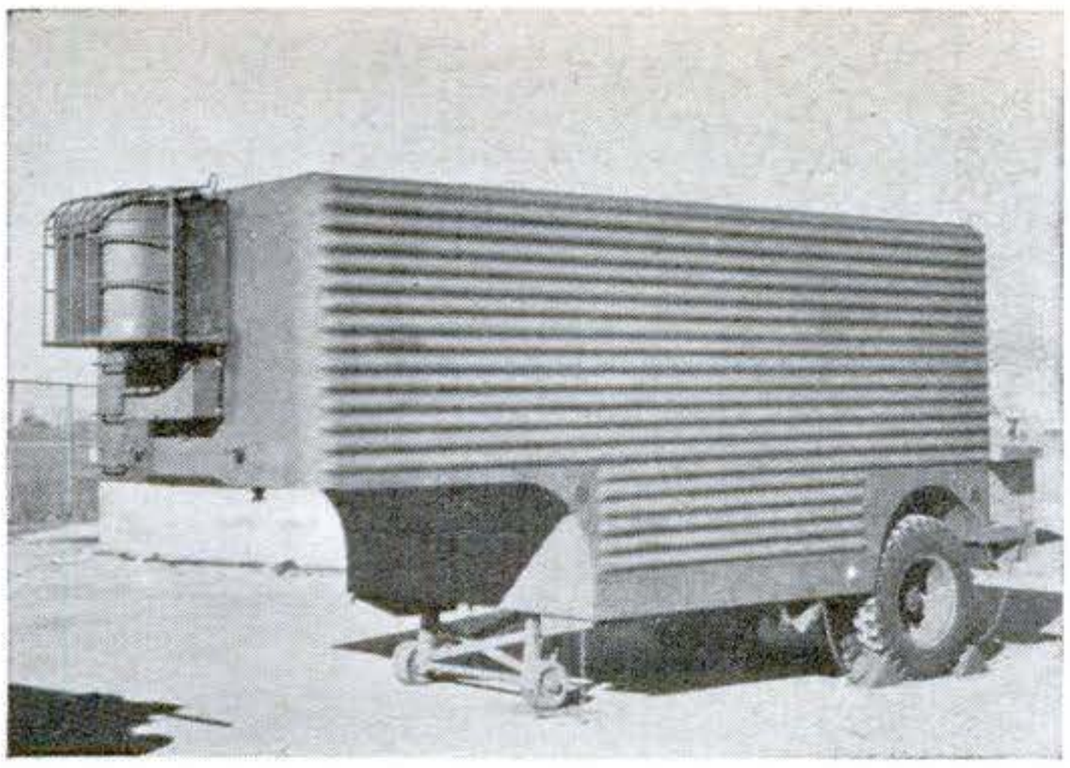
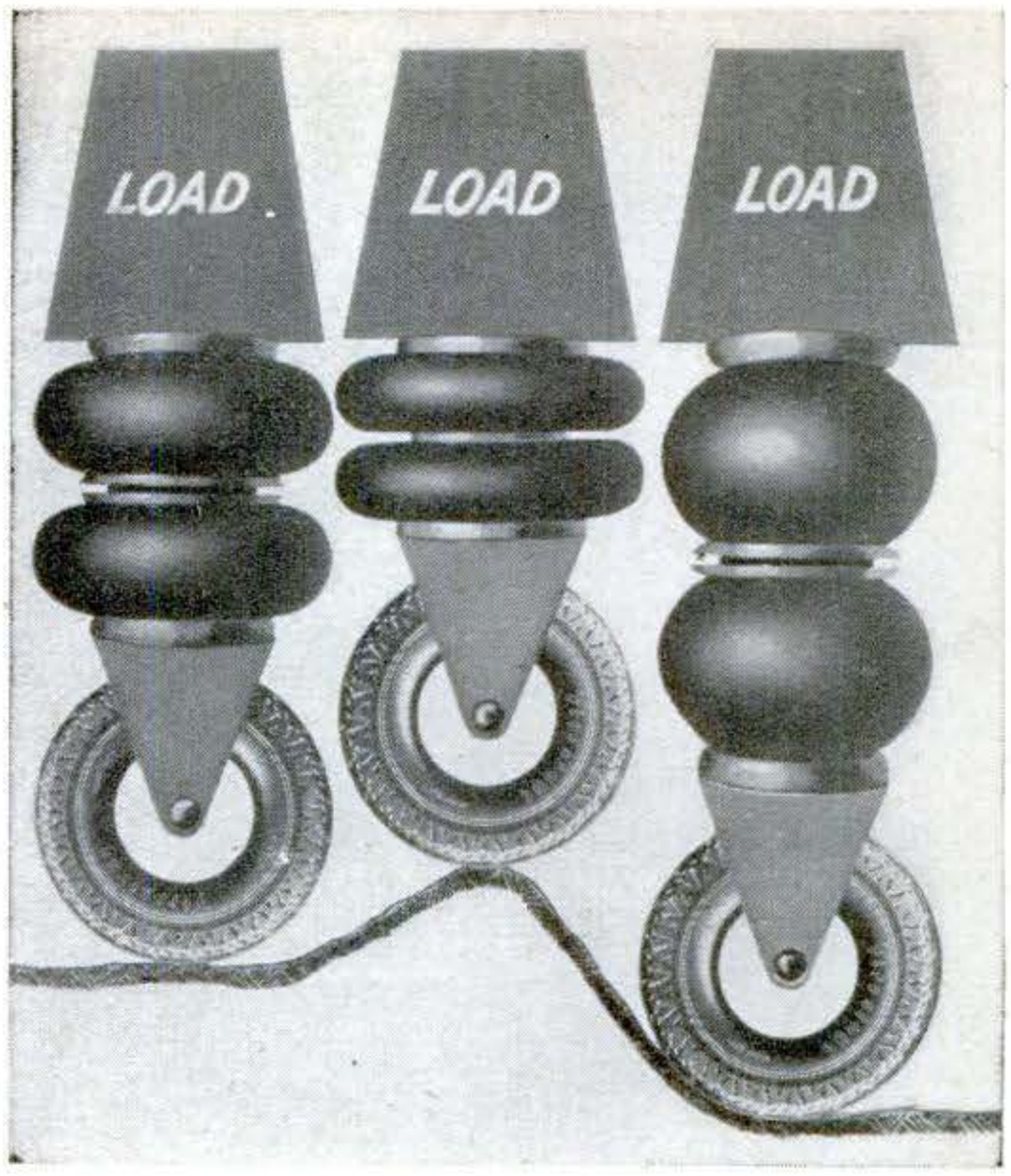


Air bellows were used in place of metal springs on the trailer above. The bellows, made of rubberized fabric, are connected to metal compression tanks.



Three views show how the air spring works. Left, it is in normal position. Center, a high place in the road compresses it. Right, it extends as wheel drops into depression, but the load remains level.

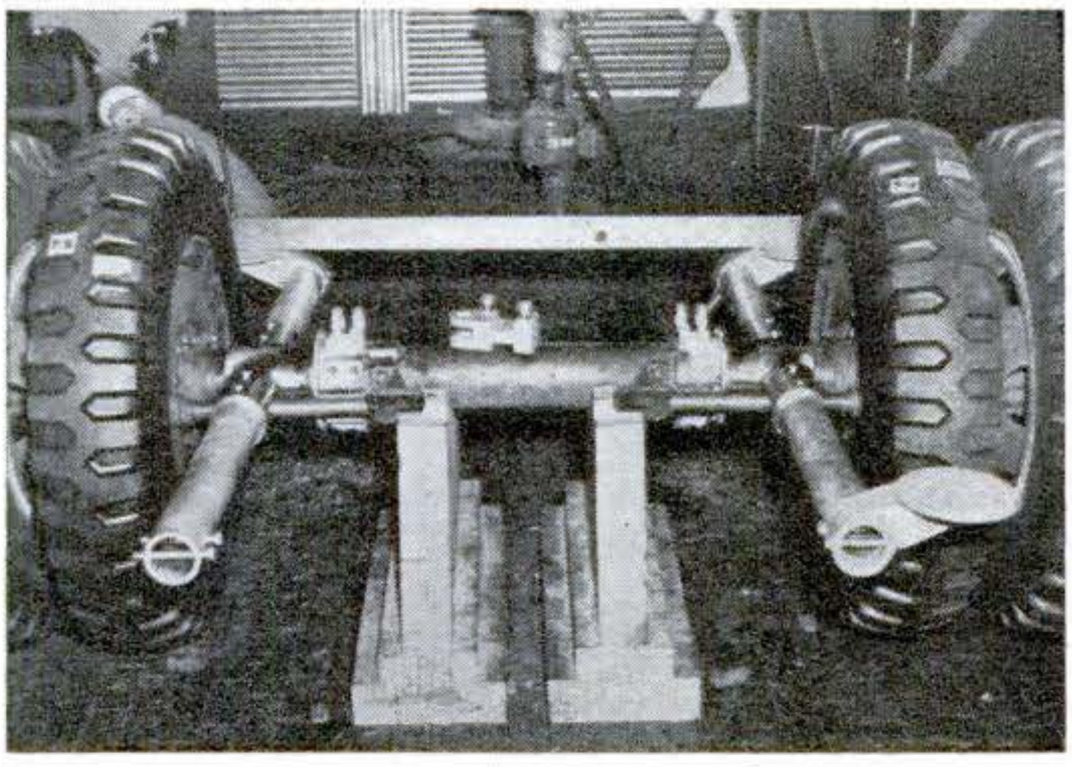
SPRINGLESS TRAILER RIDES ON AIR BELLOWS

BELLOWS containing compressed air may take the place of metal springs in your car of the future. Such bellows, made of rubberized fabric, are employed in a new method of absorbing road shock developed by the Firestone Tire & Rubber Company. To give it a practical test, the system has been installed on a huge trailer built for the U. S. Army.

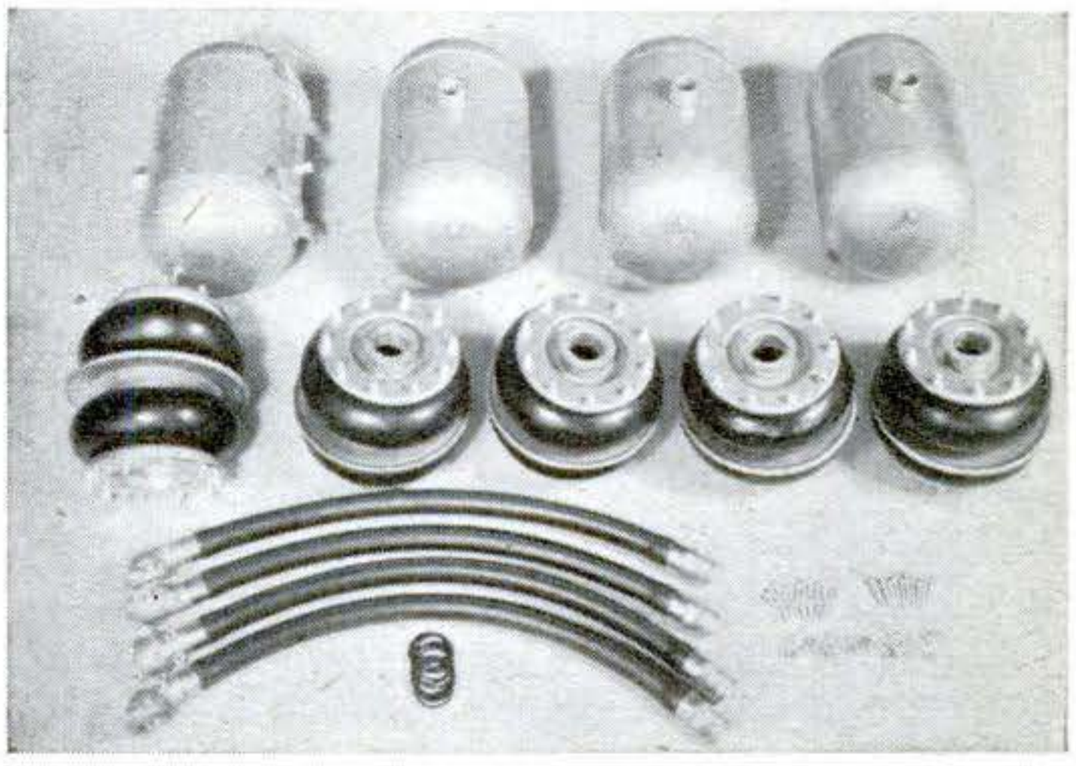
Four bellows, four metal compression tanks, and four hose attachments are used. Inflated with sufficient air to support the desired load, each bellows is connected to a tank through an adjustable valve, and the air in the tank thus serves as a cushion for that in the bellows. The valve permits free flow of air from the bellows to the tank but restricts its return. Tests indicate that this prevents excessive recoil.

On the Army trailer, two longitudinal beams were welded to the axle, and the bellows were seated between metal disks at the end of the beams and similar plates attached to the trailer immediately above.

The installation weighs 300 lb. less than a set of metal springs. In building the trailer, the Fairchild Aircraft corporation also obtained a 51-percent reduction in the weight of the vehicle itself by employing aircraft materials and construction.



Longitudinal bars welded to the axle provide seats for the four air bellows that cushion the trailer.



Here are the parts—compression tanks at the top, bellows in the center, and hose attachments below.

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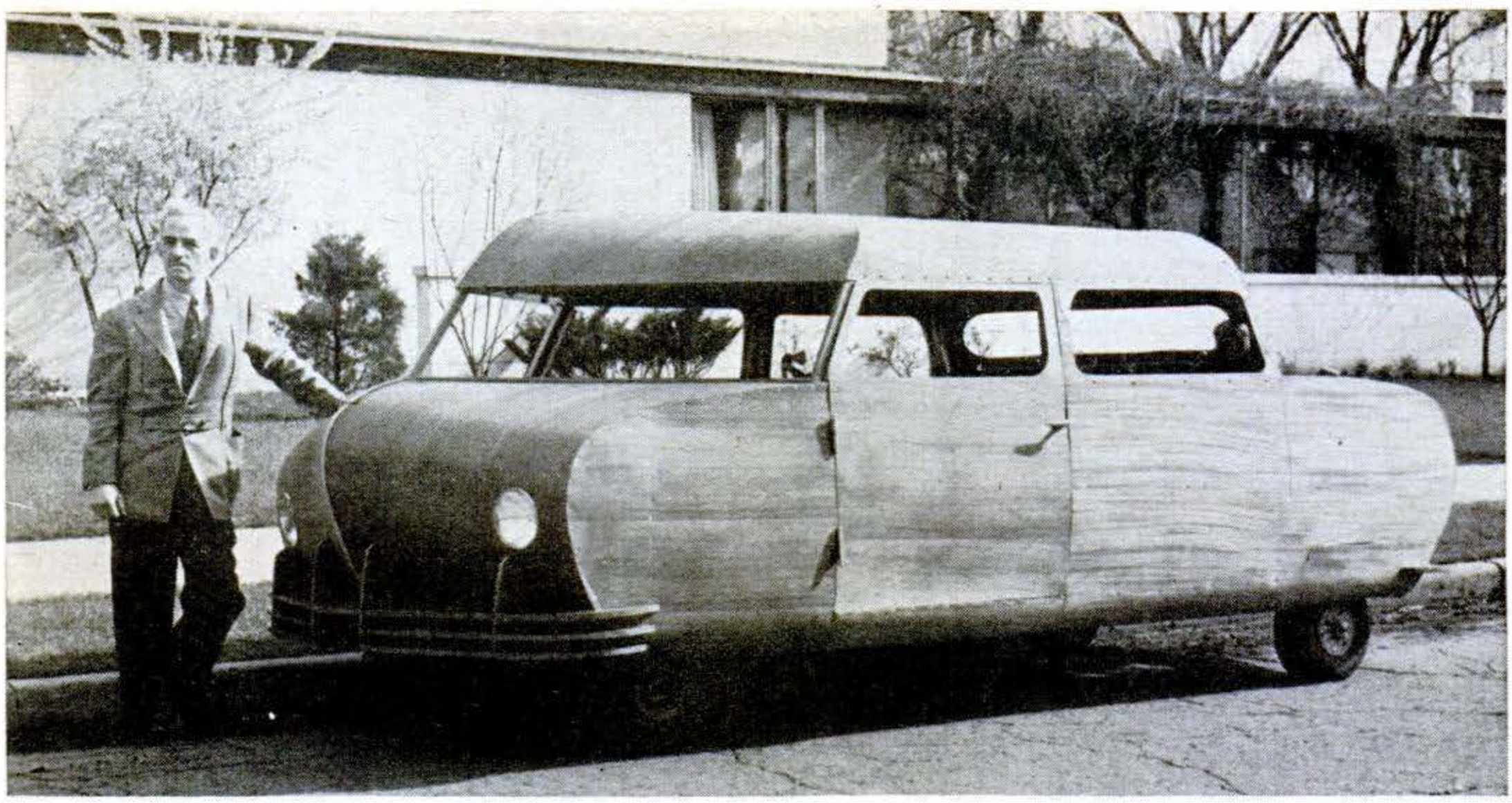


Russell's experimental model has a rather crude plywood body, but may presage sleek cars to come.

OIL PRESSURE DRIVES NEW GEARLESS CAR

By Charles T. Pearson

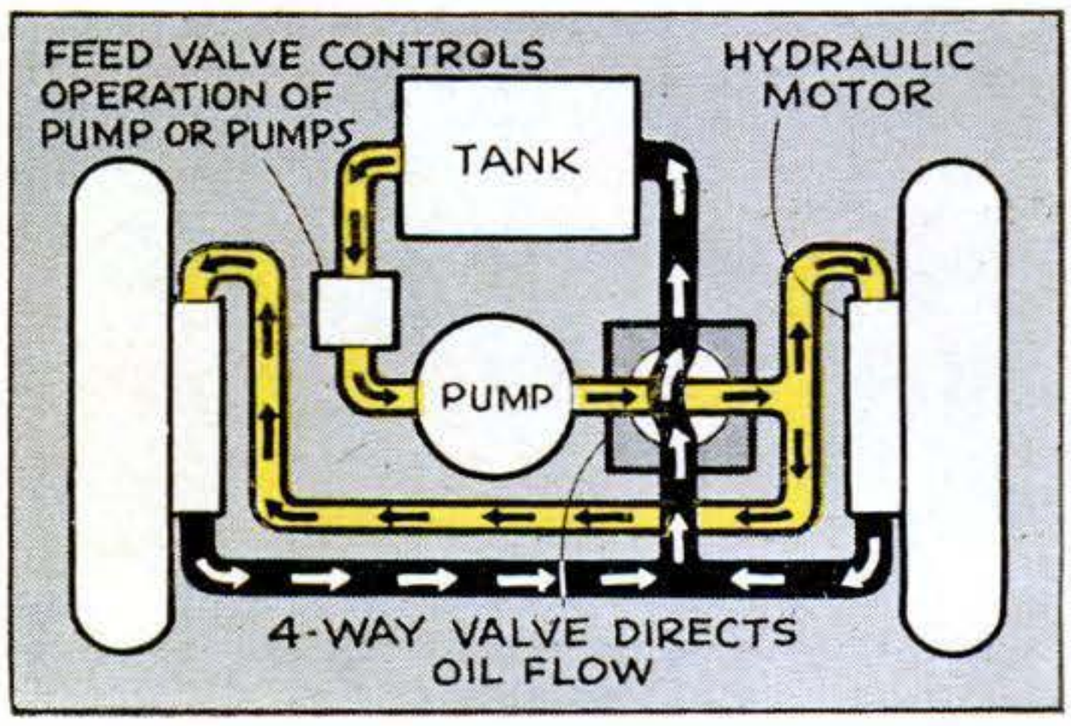
LACKING a transmission, drive shaft, and differential, a revolutionary new car has been undergoing tests in Detroit. Several pumps are directly connected to the engine crankshaft, and oil under high pressure is forced through pipes to "motors" located at the wheels. Among the advantages claimed for this new drive are flexibility of operation, new freedom in body design, and savings of weight ranging up to 800 lb. as compared to conventional cars.

Though the idea of a full hydraulic drive is not new, past endeavors to develop the principle never passed the experimental stage. For the last four years, a Detroit engineer and industrial designer named Ray Russell has been at work on the pump-and-remote-motors idea, and has produced the experimental models shown above and at the right. Lately he has been retained by the Ford Motor Company, reportedly to supervise hydraulic-drive developments.

Full hydraulic drive should not be confused with the hydraulic coupling that has been used on many cars built since the late thirties. In these the fluid coupling is merely a link between the engine and the drive shaft, and still requires a geared transmission, either manual or automatic, a drive shaft, and a rear axle.

Simplicity of operation is one feature that Russell believes will win public acceptance to full hydraulic drive. The only pedals on the floor board may be the accelerator and brake. A single valve that changes the direction of oil flow takes the place of the conventional reverse-gear system. Other valves, possibly automatically controlled, cut in or out the pumps used and thus change the effective ratio between engine and wheels.

With three pumps of different capacity connected to the engine shaft, seven forward and reverse speeds are possible; with four pumps, 15 different speeds or ratios can be had. As shown schematically in the accompanying drawings, the basic valve action and pipe circuits required to control a hydraulic car are not complicated. All pumps



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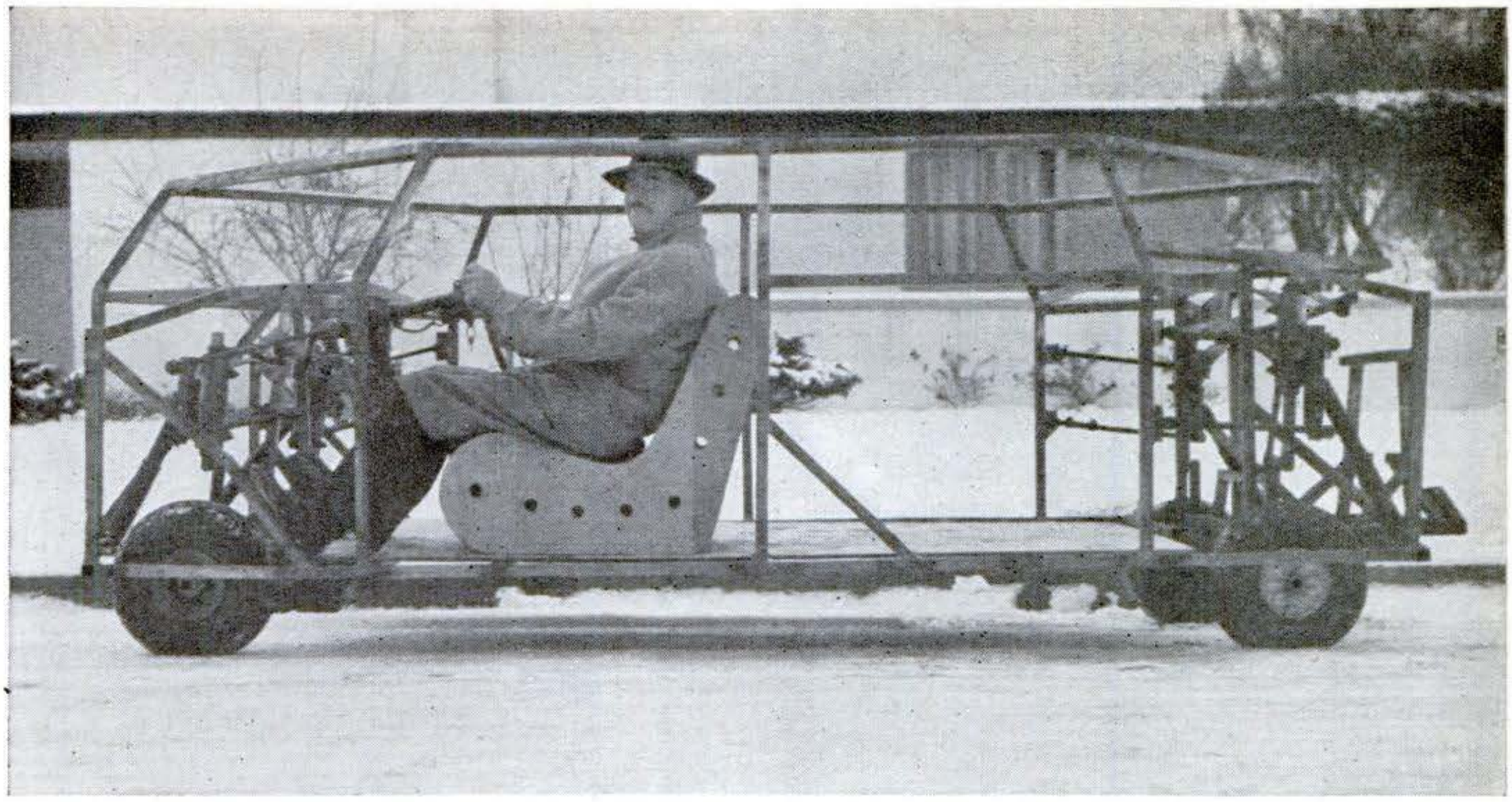
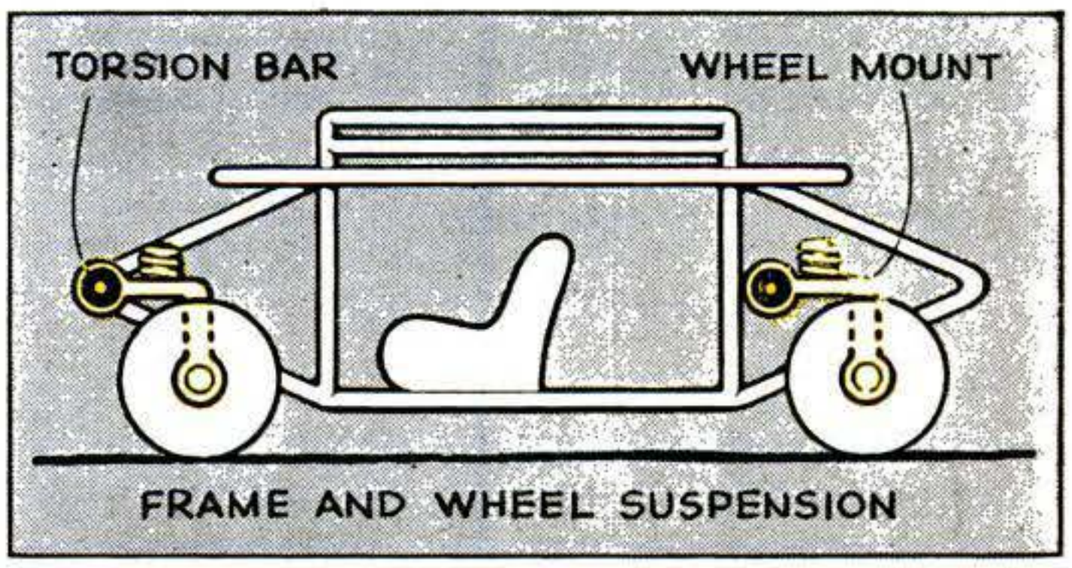
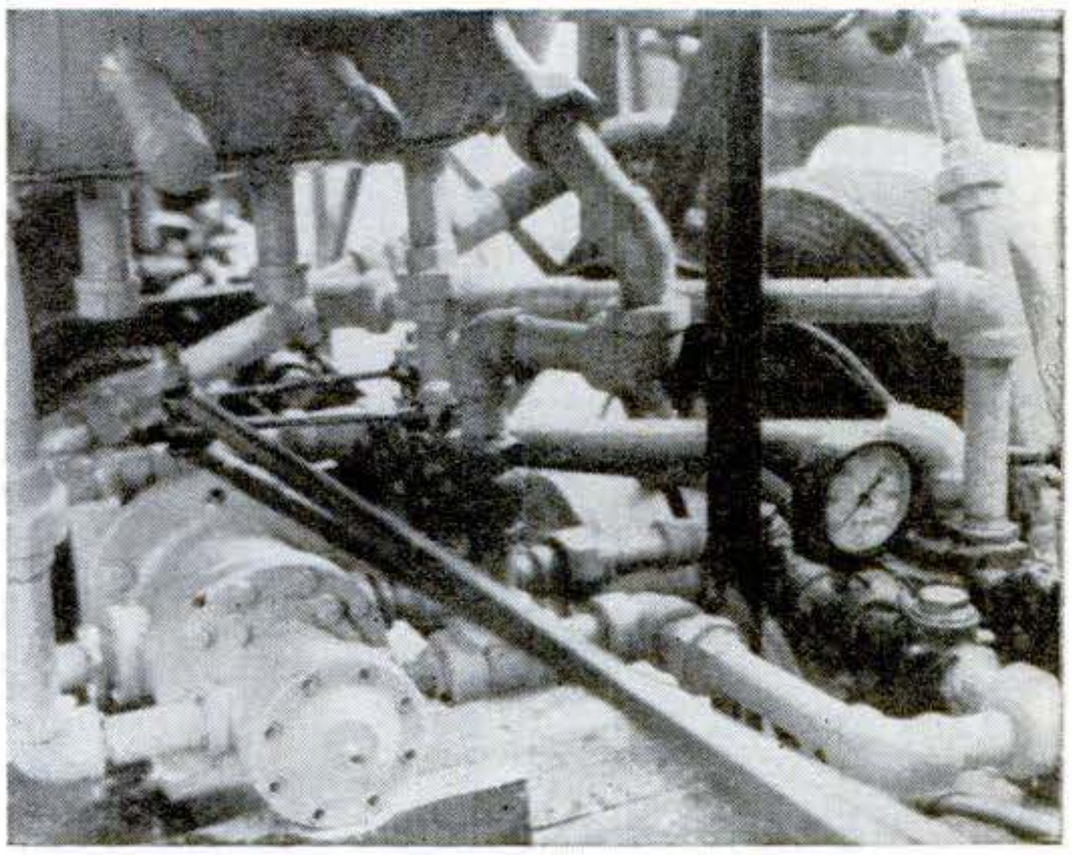


Above, the steel framing of the experimental model; regular auto wheels were substituted later. Piping system, shown in photo at right below, would be simplified in production by use of steel tubing.

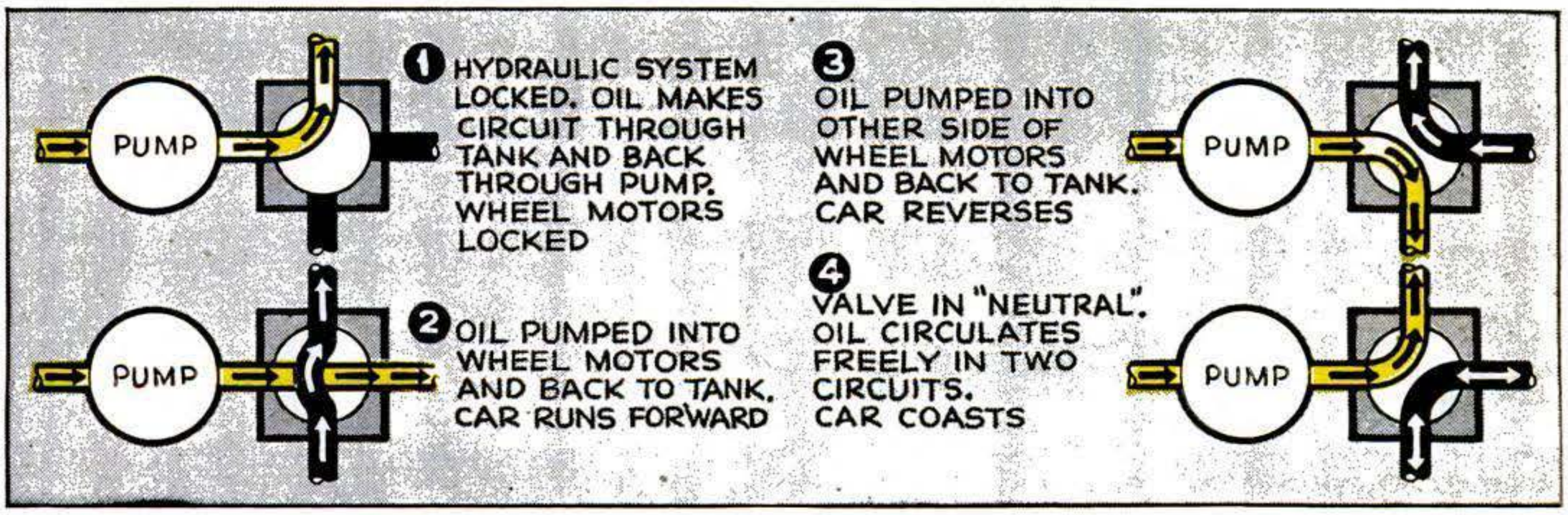




turn with the engine, but only those operate in the hydraulic system that are cut into it by their feed valves. A pump that is temporarily cut out of the system by closure of this intake valve absorbs negligible power.

The directional movement of the car (as contrasted to engine-to-wheels-ratio) is controlled by a four-way valve, which determines the direction of the oil flowing in the wheel-motor circuit, and which disconnects the engine and wheels when desired. By restricting or even reversing the flow of oil through the motors, it is possible to exert a powerful braking action that will greatly supplement that of conventional brakes.

In test runs Russell's model is said to have displayed smooth, silent acceleration, with plenty of power delivered at the wheels and without excessive heat in the hydraulic system. Pressure reached 1,000 lb. per



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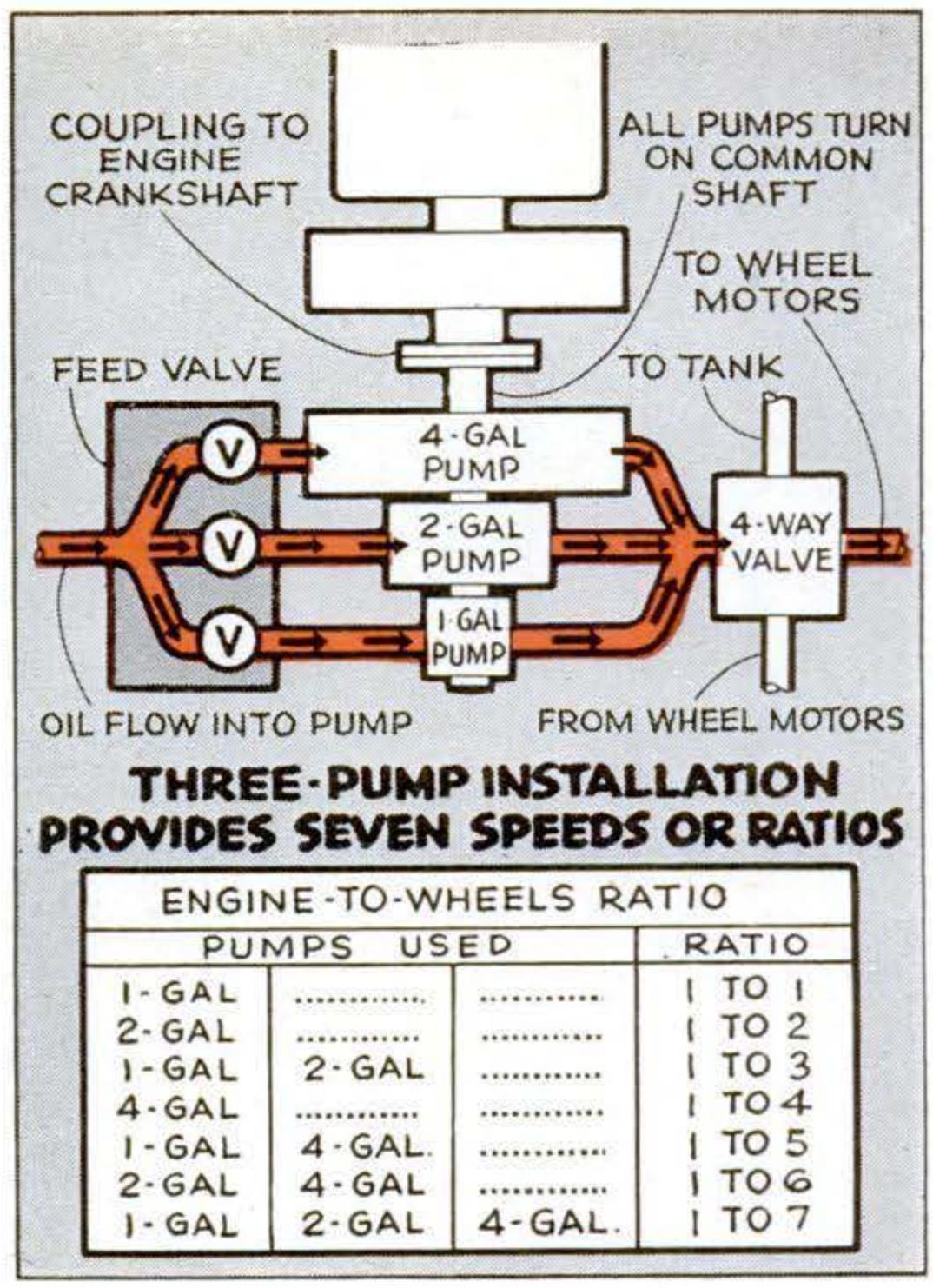
Ray Russell, a Detroit engineer, believes that his hydraulic drive may be the next big advance in car design. Right, a typical multiple-pump installation shows how hydraulic action does the work of gears.



THREE-PUMP INSTALLATION PROVIDES SEVEN SPEEDS OR RATIOS

ENGINE-TO-WHEELS RATIO			
PUMPS USED			RATIO
1-GAL	.....	.....	1 TO 1
2-GAL	.....	.....	1 TO 2
1-GAL	2-GAL	.....	1 TO 3
4-GAL	.....	.....	1 TO 4
1-GAL	4-GAL.	.....	1 TO 5
2-GAL	4-GAL	.....	1 TO 6
1-GAL	2-GAL	4-GAL.	1 TO 7

square inch during starting, and dropped to 200 lb. after highway speed was reached. It is reported that temperature of the hydraulic system did not exceed 10 deg. above atmospheric temperature during the tests.

The design of the wheel motors has not yet been finally determined. It seems likely, however, that the most efficient motors will not resemble turbines, but will be similar to positive-displacement pumps. Thus the motor is nothing but a type of pump which, instead of being driven by a rotating power source, is turned by having oil forced through it. Wobble pumps, gear pumps, and internal-rotor pumps are all capable of being adapted for use as motors.

The weight of the entire hydraulic installation is estimated at a quarter of the weight of the equivalent mechanism now used between the engine and the wheels. Russell believes that the total weight of his car need not exceed 2,000 lb. He also feels that the new design will lend itself to simplified servicing, with an engine assembly that can be taken out and replaced in less than an hour. An airplane-type multiple connector will fasten gasoline and electrical lines to the engine. Engines could be made available on a rental basis, as batteries now are, while the original one is rebuilt.

From the viewpoint of the body designer, the hydraulic drive offers new freedom. The engine can be placed almost anywhere in the car, even at right angles to the chassis. There is no need to allow space for the transmission, drive shaft, or differential. As Russell sees it, unprecedented interior comfort will be possible, with full vision for the driver, who will be located somewhat farther forward than now, and with a larger windshield. He says that doors will be "man-sized," and that seats may be wide enough to accommodate four persons side by side. The luggage compartment will be under the shortened hood in front, and the engine will be in the rear, where noise, vibration, and fumes will be minimized.

More recently, Russell has revealed a design for a small personal car for short trips. Known as the "Gadabout," it will have the same hydraulic drive as full-size models, but will be built with a welded-steel framework that completely encircles the car to increase protection in case of crack-ups. Wheels will be individually suspended, using an airplane-type mounting combining a coil spring and torsion bar. Present plans call for the "Gadabout" to be powered by a light air-cooled two-cycle engine.

Another idea in the back of Russell's head is the special adaptability of the hydraulic drive to amphibian design. Since the only power-transmitting connections between the engine and the wheels are the hydraulic lines, it would be simple to run these lines through the hull with waterproof couplings and gaskets. Several amphibians are on Russell's drawing board, adapted both for

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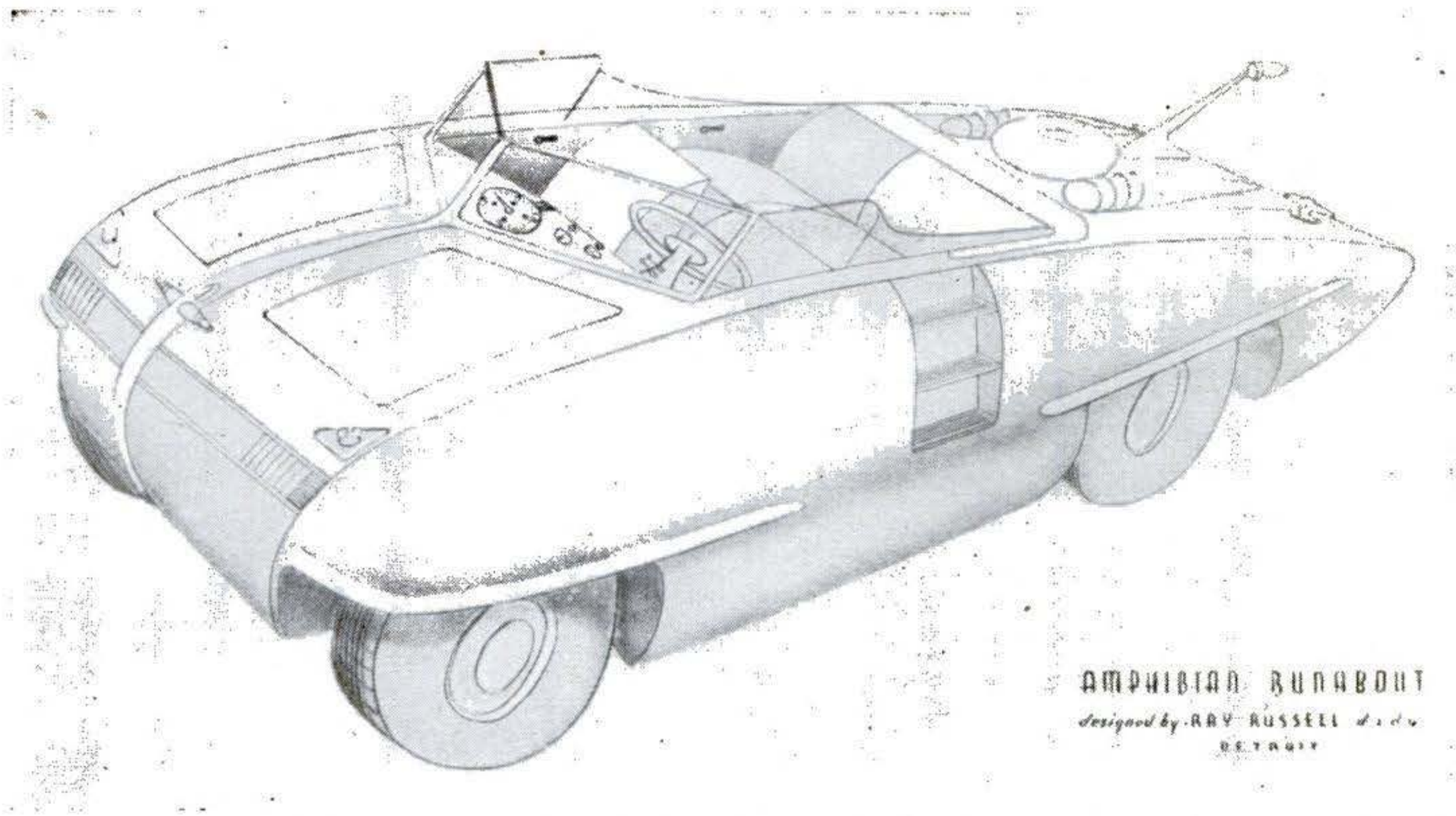

The engine can be located where needed for balance, so hydraulic drive would be good for amphibians.

pleasure and for use by farmers and others.

Still another place where the hydraulic drive might have special advantages is in the much-discussed "roadable airplane." Probably the plane best adapted to road use by the addition of hydraulic drive is the Spratt Controllable Wing, which has four wheels like an automobile and has approximately the same tread and wheel base. It would be comparatively simple to add a clutch that would disconnect the propeller for road use and cut in the hydraulic system. A plane installation would probably not require more than two oil pumps, which would give three forward speeds.

The applications of hydraulic power have increased tremendously during the past few years. Automobile makers already use hydraulic power to raise and lower windows at the touch of a button and to raise and lower the tops of convertibles. They have also already completed designs for hydraulic cylinders that open or shut the hood and rear deck, and that move the driver's seat forward or backward. Whether or not this versatile power-transmitting method is equally adaptable to driving the wheels of a car remains to be seen. Some technical critics retain a skepticism as to the efficiency of Russell's drive, particularly in respect to internal friction. How well founded these doubts are can only be determined by carefully controlled tests, conducted over a period of time.

The Spratt controllable-wing plane might be made a "flyable car" with the addition of a hydraulic drive.

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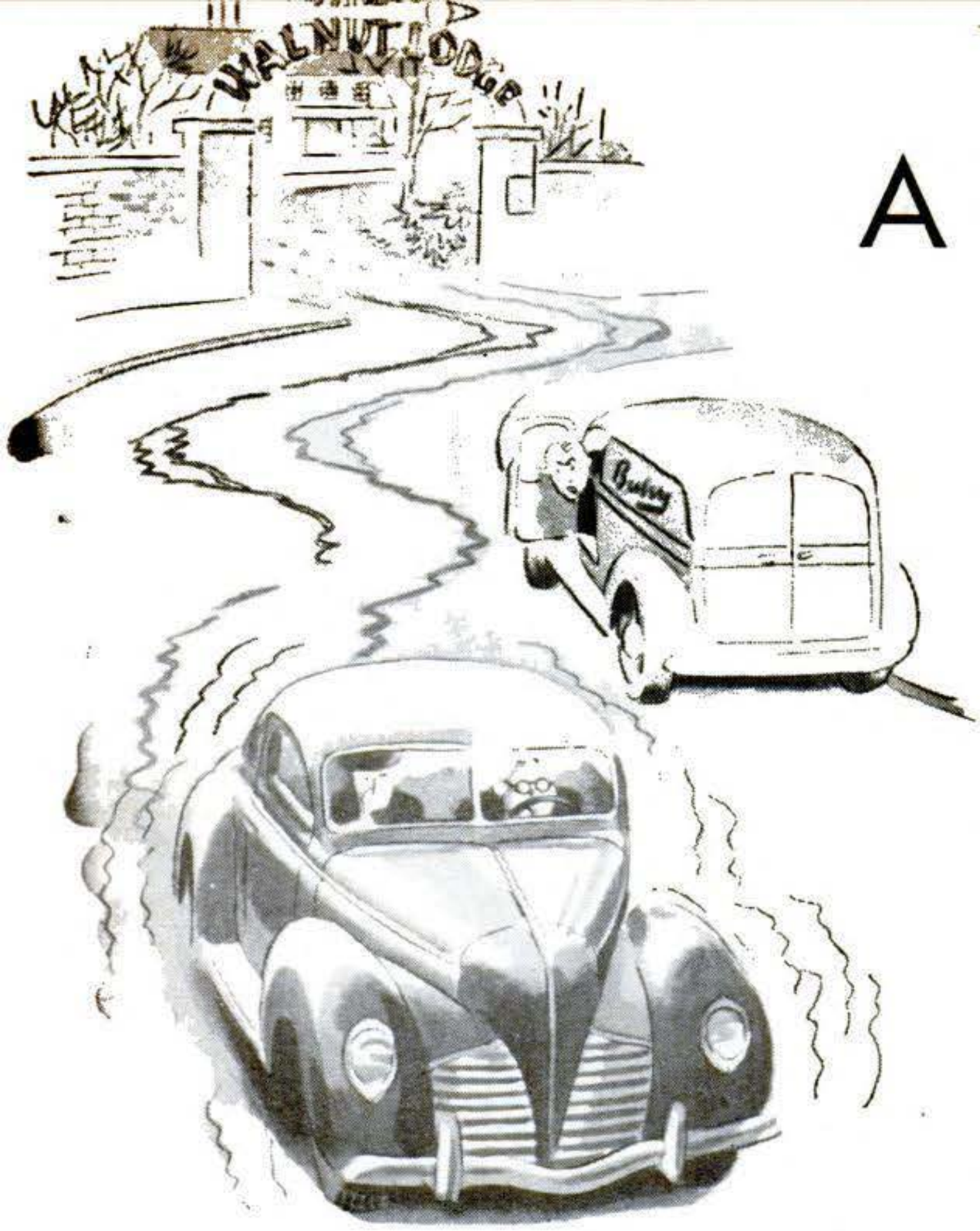
A Nut Gets Loose



"My car is subject to convulsive contortions. . . ."

"AND that, gentlemen," wound up the speaker, blinking his pale-blue eyes rapidly and running nervous fingers through his unruly mop of sandy hair, "that is the mission of the psychiatrists of the professional staff of Walnut Lodge—to restore to those unfortunates their priceless heritage of mental stability and emotional tranquility. Gentlemen, I thank you."

He sat down and modestly sipped water as the patter of polite hand clapping mingled with the scraping of pushed-back chairs.

A man who had slipped into a chair at Gus Wilson's right just as the speaker started leaned close and spoke in a low but deep voice. "An interesting experiment," he said. "Or, more accurately, a convincing demonstration of what the scientific treatment at Walnut Lodge accomplishes."

Gus looked attentively at his neighbor for the first time. He was portly and well dressed, apparently in his fifties. A bald spot bordered by fringes of graying hair added to a high and bulging forehead. Keen blue eyes peered through rubber-tired spectacles. His manner was portentous but at the same time placid. Gus couldn't remember having seen him before, but the name "Dunbar Coleman" lettered on his visitor's badge jiggled some faint recollection.

"You agree with me, I hope, sir?" his new acquaintance inquired.

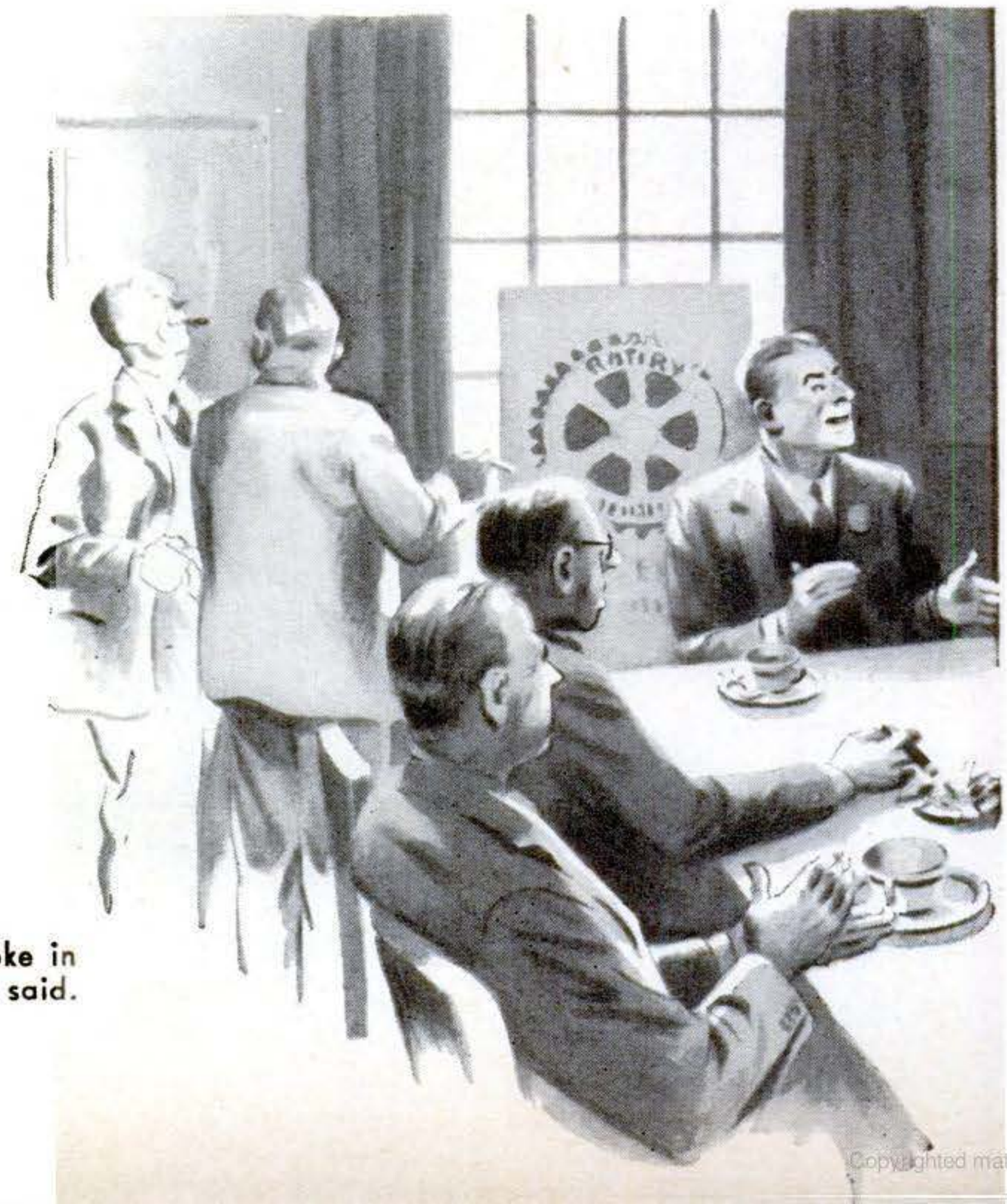
"I'm afraid," Gus had to admit, "that I don't quite understand."

"Of course—*of course,*" the portly man interrupted in a soothing tone. "I'll explain. But first allow me to introduce myself—Dr. Coleman Dunbar, chief of the Walnut Lodge psychiatric staff."

Gus's jaw sagged, and he took a hasty look at his luncheon program. "I'm afraid that I still don't get it," he said weakly. "According to my program, Dr. Coleman Dunbar is the man who talked to us."

"Ah—*that's* the point," his new friend told him. "Mr. Dunbar Coleman, the gentleman who spoke and is now congratulating himself—and justly—on being a very clever fellow, is one of our patients. He is recovering—no, he has recovered—from a mental maladjustment, resulting from his parents refusing to permit him to suck his thumb when he was a small child, which made it impossible for him to talk to more than one person at a time.

"The inverse similarity of our names—



The man at Gus's right leaned close and spoke in a low voice. "An interesting experiment," he said.

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in the Model Garage

By Martin Bunn

Coleman Dunbar, Dunbar Coleman—ha, ha! —suggested to me an experiment to demonstrate Mr. Coleman's complete cure and to convince him that he *is* cured. I exchanged visitors' badges with him and induced him to address this gathering under my name. Mr. Coleman now *knows* that he can talk to more than one person at a time.

"Momentarily he thinks that he is Dr. Coleman Dunbar and that I am one of his patients, but that mild delusion is inconsequential. You follow me, I trust?"

"Oh—of course," Gus said uncertainly.

The portly man's eyes were on his badge. "Gus Wilson," he beamed. "Can it be that I am so fortunate as to meet *the* Gus Wilson of whom I have heard so much—the mechanical wizard who cures all automotive troubles in the wink of an eye?"

"I wouldn't say that," Gus protested.

"Fortunate," the other rejoined. "Distinctly fortunate! My car is causing me serious annoyance. Under certain road conditions it is subject to convulsive contortions. If you will pardon a vulgar but expressive phrase, it gives me the jitters—ha, ha! Before I return to the tranquility of Walnut Lodge, I shall stop at your establishment and ask for a diagnosis. Until then, Mr. Wilson, good day."

Gus scratched his head as he watched him make his way to the luncheon speaker. "I'd better get back to the shop," he muttered, "before *I* go nuts."

AN HOUR later Stan Hicks came into the Model Garage shop with a wide grin on his grease-streaked face.

"Mr. Clark has a pair of screwballs in the office," he told Gus. "They've got a car they want fixed, but they can't make up their minds what their names are or which one owns it. He's bringing 'em in here."

Joe Clark, looking somewhat dazed, came into the shop with Gus's acquaintance and the man who had addressed the luncheon. "Two gentlemen who want some work done," he said weakly. "Gus, meet Dr. Dunbar."

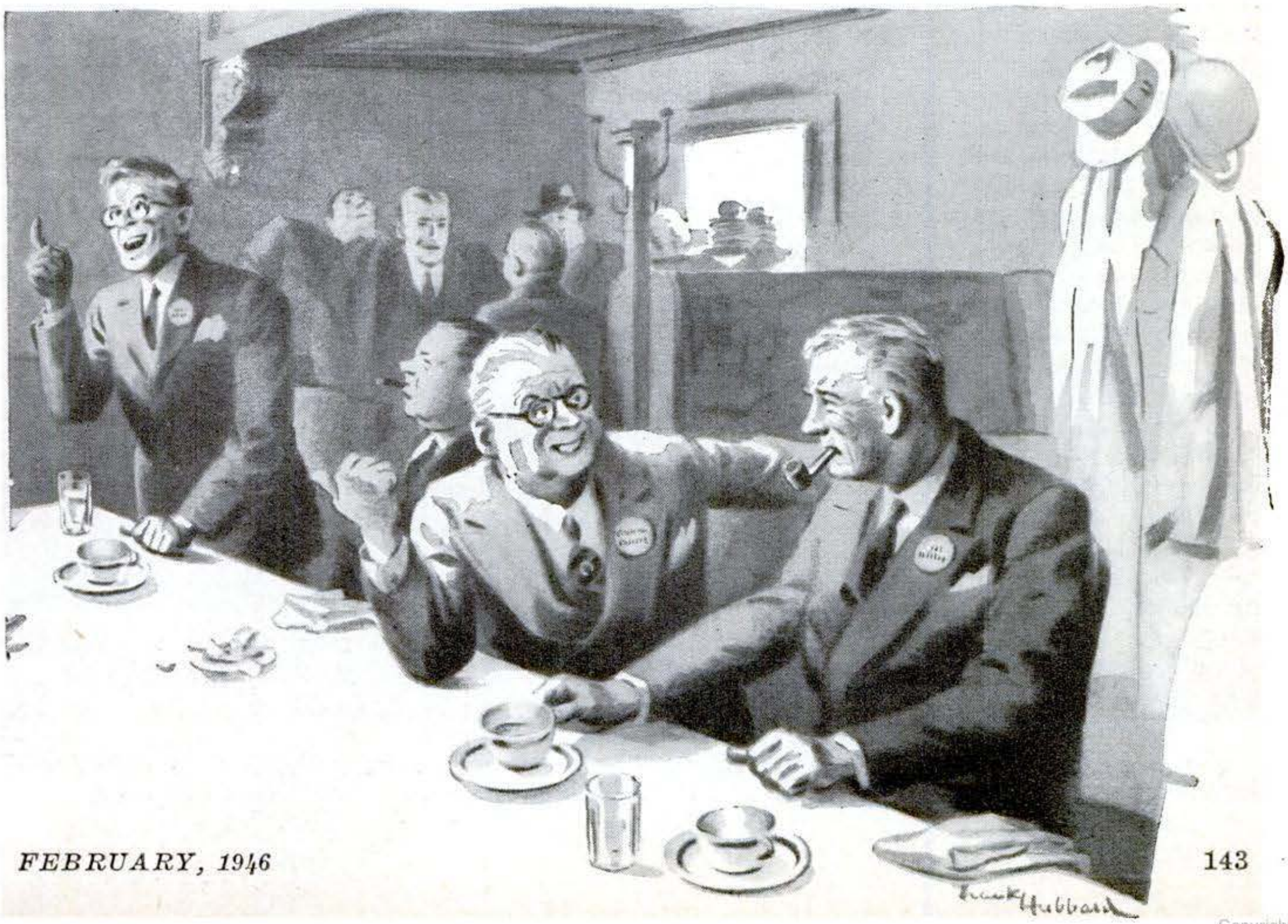
Both stepped forward and shook Gus's hand.

"And Mr. Coleman," Joe added.

Neither caller moved. Then the man who had addressed the luncheon jerked an elbow viciously into his companion's ribs.

"Pleased, I'm sure," the portly man said as he again shook Gus's hand. He added in a whisper: "I'll humor him—it's safer. The transitory delusions, which are a common aftereffect of the Von Affengesicht treatment, occasionally result in violence."

"Excuse me," Joe Clark put in. "I hear the phone ringing." He left hastily.



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"Dr. Dunbar told me this noon," Gus said, "that he wanted me to look at his car."

"*I* told you!" the sandy-haired man shrilled. "I never laid eyes on you before."

"Pay no attention to him—poor fellow," the portly man said. "Yes, Mr. Wilson, I would appreciate it if you would examine my car, and—"

"*Your* car!" the sandy-haired man grated bitterly. "Why, you . . ."

Gus was dizzy. Stan, pale around the gills, was edging toward the door.

"There's someone wants gas at the pump," Stan muttered, but Gus grabbed him. "You stay here," he snapped.

"Come, gentlemen, let us tranquilize ourselves," the portly man said finally. "That unfortunate similarity of names—Dunbar Coleman, Coleman Dunbar, ha, ha!—not infrequently causes confusion. By dispensing with formality we will both dispel that confusion and create an atmosphere of simple friendliness in which we can transact our business . . . Just call me Dunbar."

"And just call me Coleman!" his companion added.

Gus's brain went into a tailspin. "That's—that's just dandy," he said, and let go of Stan's coveralls. "*If* there's a car outside," he ordered, "bring it in!"

A HALF minute later Stan drove a blue coupe into the shop. "Runs swell," he told Gus as he got out of it.

The portly man looked at Stan as if he were some breed of mildly interesting insect, and then turned to Gus.

"As I told you at luncheon," he said, "under suboptimum road conditions my car indulges in convulsive contortions which are disturbing even to a person, such as myself, who enjoys perfect mental balance. In spite of all my efforts—and I may say without false pride that I am a skilled driver—the car continually swings from one side of the road to the other.

"It has been thoroughly examined in several reputable repair shops; its wheels have been checked and rechecked for balance and trueness. The last mechanic I consulted said that the trouble—weaving, he termed it—was caused by worn kingpins. New pins were installed, but there was no improvement."

He leaned close to Gus and lowered his voice to a whisper. "Slowly but surely," he confided, "it is driving me as daffy as my poor patient over there who suffers from the delusion that he is I and my car is his. Do you know where I can get some Little Neck clams?"

Gus jumped as if a bee had stung him.

"What!" he yelped. "What have clams got to do with—Try a sea-food store!"

The portly man nodded. "A most intelligent suggestion," he said placidly. "I'll telephone for them."

He disappeared into the office. The sandy-haired man, his pale eyes blinking furiously, grasped Gus's arm.

"This is our chance to accomplish something," he said hurriedly. "You understand the situation, of course—that it is advisable for me to humor my poor patient until I get him safely back to Walnut Lodge . . .

"What he told you about the steering difficulty with my car, which on occasion I have permitted him to drive under my close supervision, is quite correct and accurate. But he failed to tell you about a much more serious trouble. When the road surface isn't perfectly smooth, the car squeaks and groans like a lost soul. I've had it lubricated and sprayed again and again, but nothing does it any good." His voice grew shriller. "It's got on my nerves so badly that I can't bear to drive it or even ride in it. I tell you, it's driving me mad! Where can I buy some Little Neck clams?"

Gus felt a prickling at the nape of his neck. "Why," he demanded, "do both of you nu—both of you fellows want clams?"

"I don't want them—I hate them," the sandy-haired man told him. "It's my wife who wants them—she's giving a dinner party tonight. She told us to bring home two dozen. But my poor patient can't be trusted to remember anything, and I forgot all about them. She'll be furious!"

"Oh, that's it," Gus said, greatly relieved. "Well, now, you step into the office and phone a sea-food store to send them here. While you are waiting for them to be delivered, I'll try to find out what's the matter with your car."

Gus watched him go into the office.

"Quick, Stan," he told the grease monkey, "lock both the office door and the street door so they can't get back in here. Then we'll have a little peace while we check their car and get rid of them."

Stan locked the doors. "Say, boss," he asked, "which is the nut?"

"Take your pick, and you won't be wrong," Gus growled. "Get moving and jack up the front end of their car."

WHEN the car was jacked up Gus carefully measured the distance between the tops of the front wheels, and then between their bottoms. It was exactly the same.

"No camber," he told Stan. "The tops of the wheels aren't farther out than their bottoms as they should be. That's nearly always an indication of loose or worn bearings, which allow the wheels to change their camber continuous- *(Continued on page 208)*

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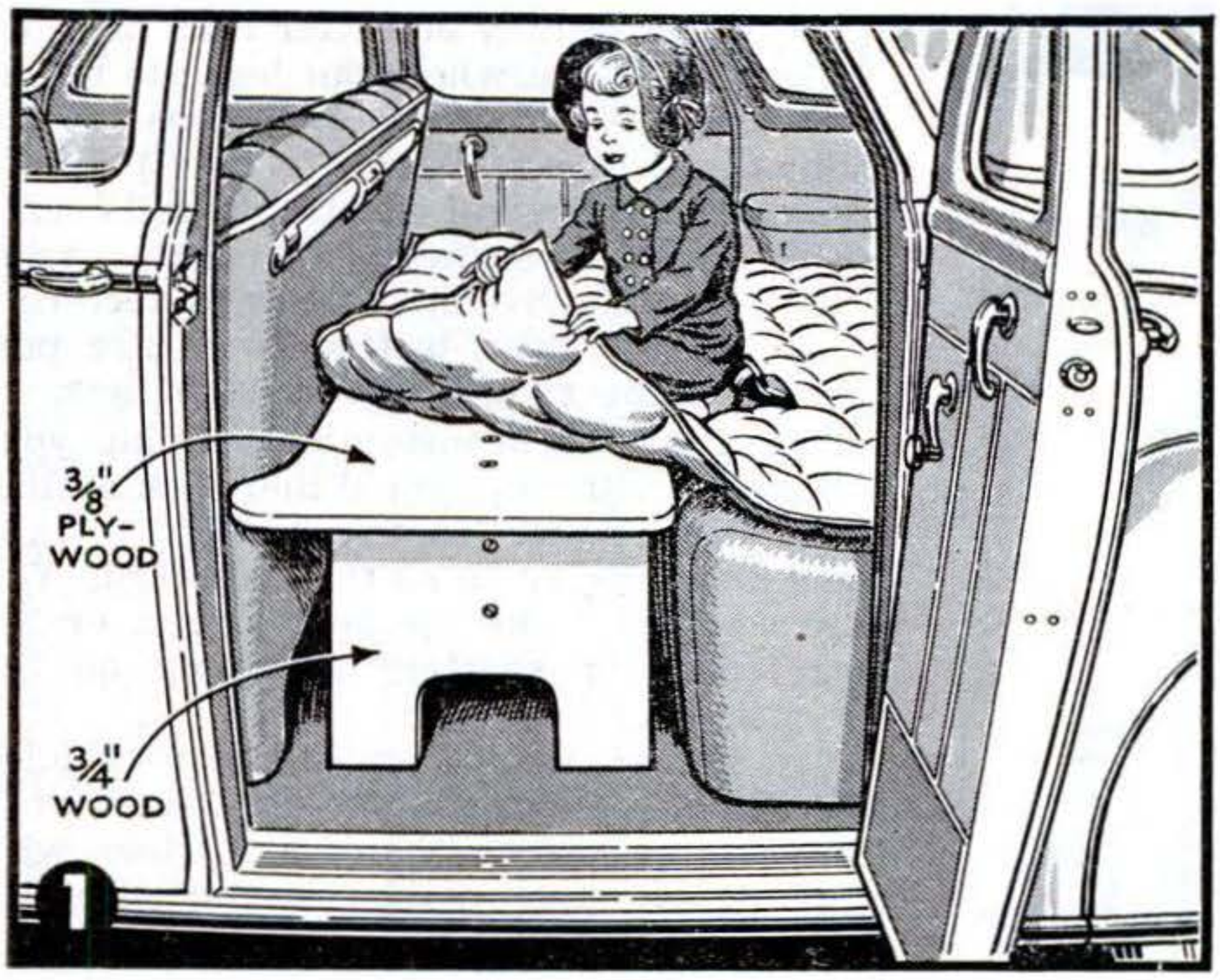
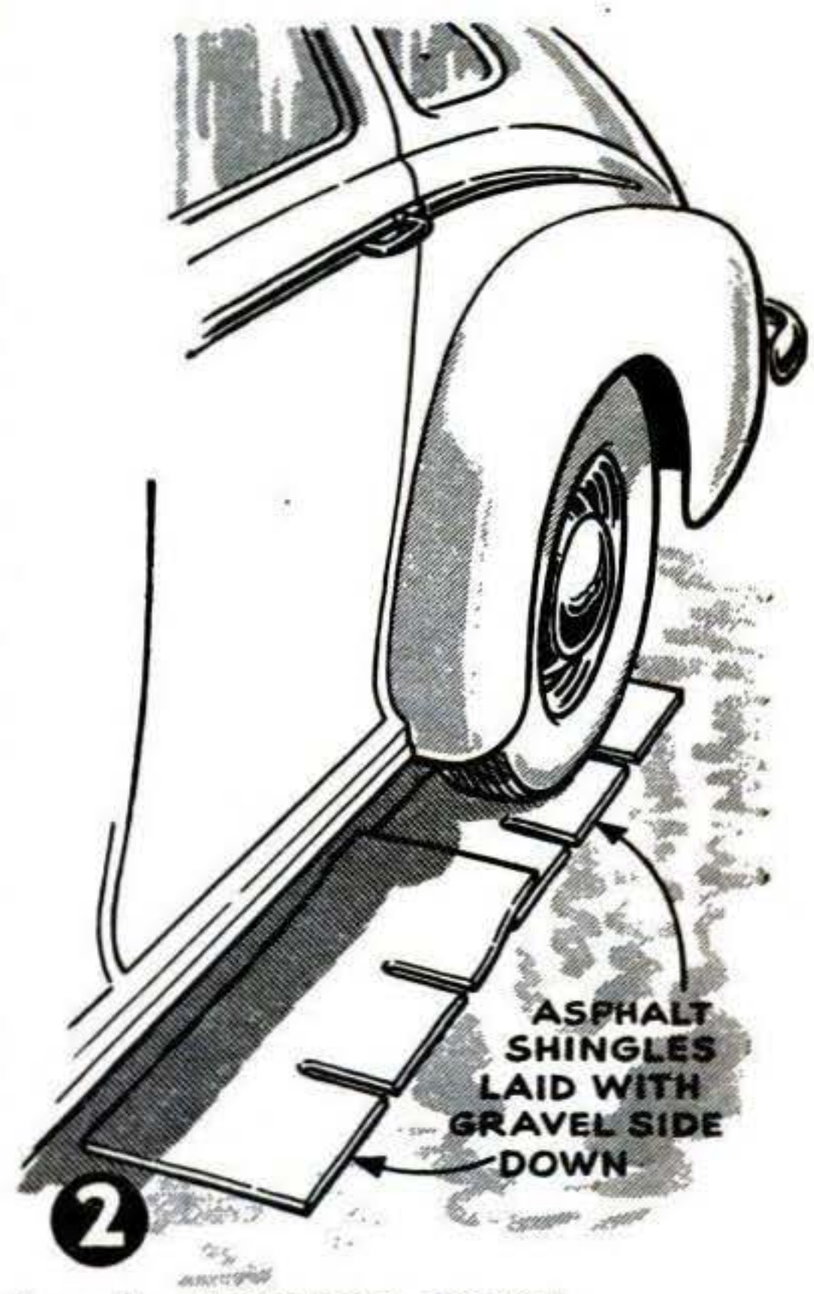
USEFUL AUTO HINTS





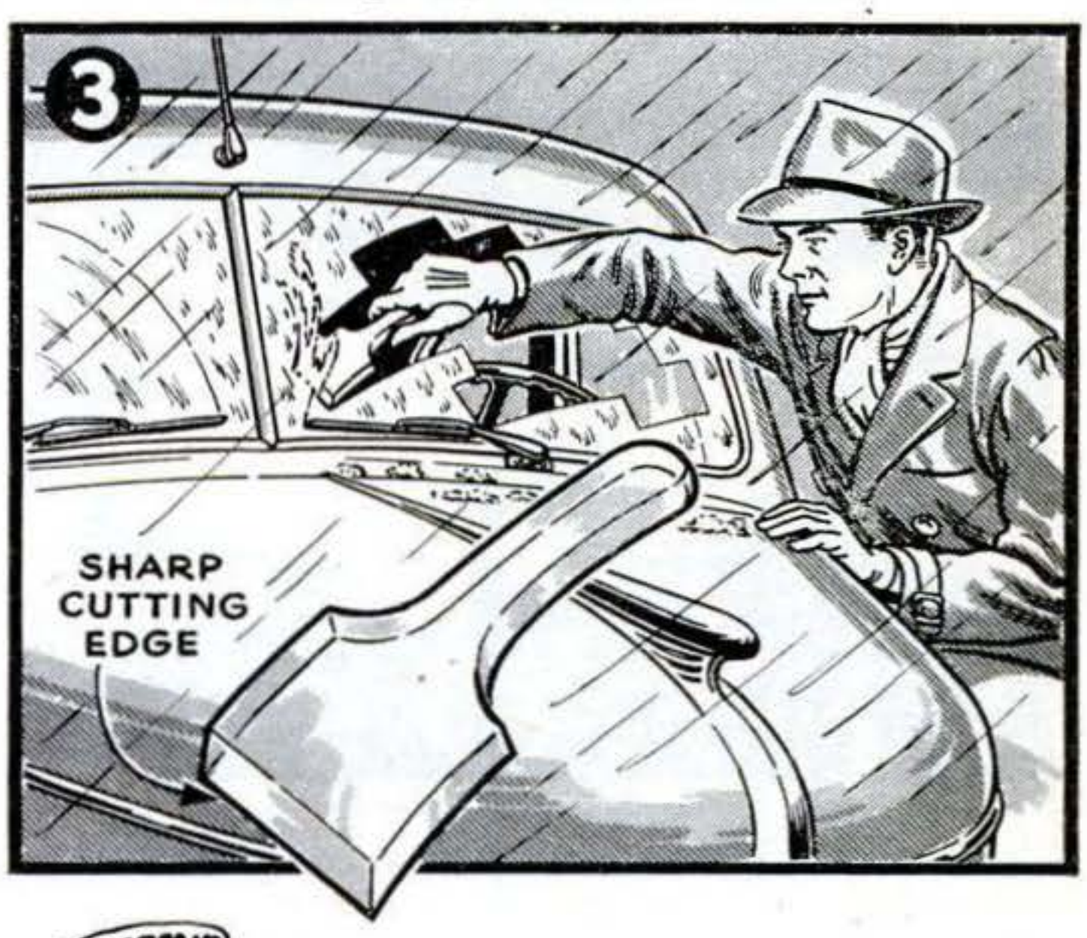
Drawings by STEWART ROUSE

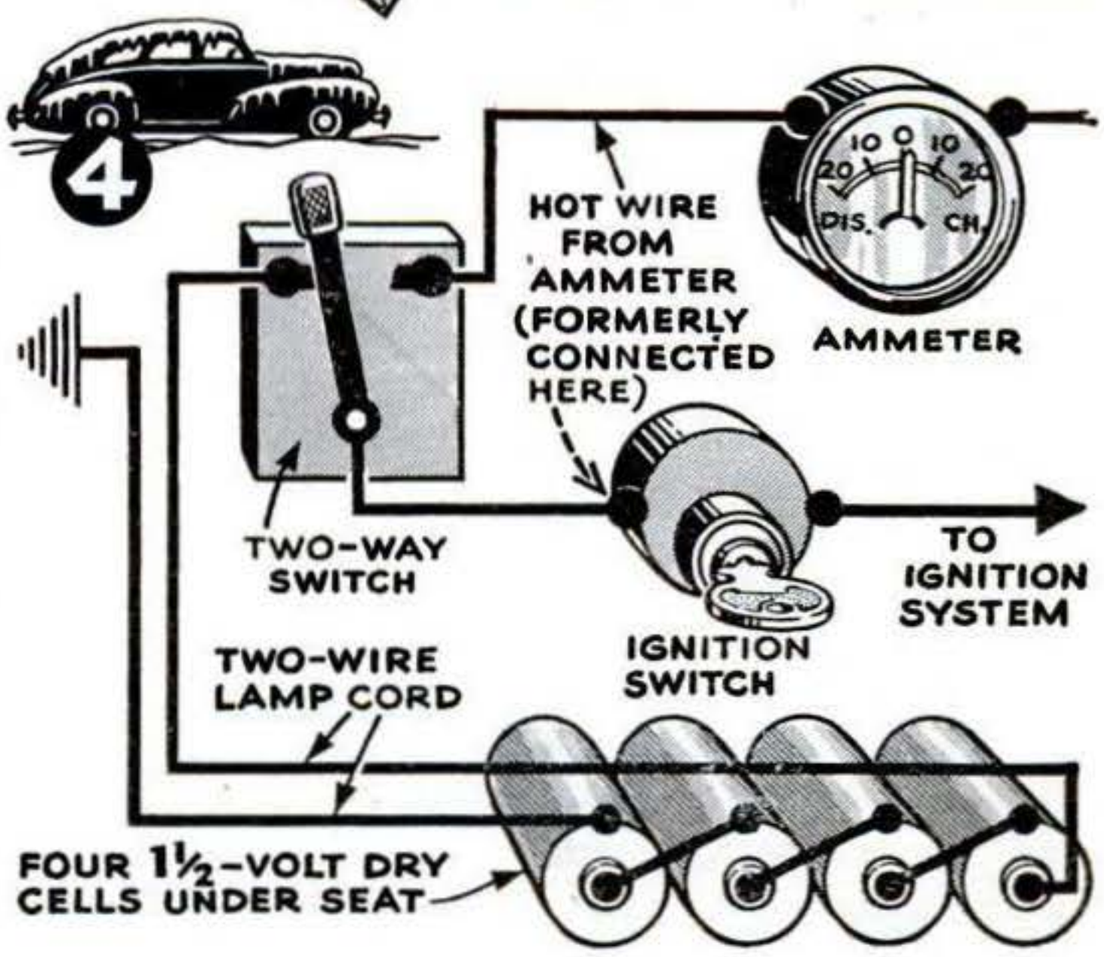
1 A BACK-SEAT PLAY PEN will give a baby room to move around in the rear of a car without falling off the seat. It's formed by sliding in a plywood-topped table the exact height of the back seat and shaped to conform to the curve at the back of the front seat. A play-pen pad or blankets cover it. There is storage space underneath.—L. P. LA P.

2 ASPHALT SHINGLES laid gravel-side down on ice or in a rut will give a car traction to get a start. They are more compact and less messy to carry in the trunk than sand or ashes.—B. H.

3 ICY WINDSHIELDS are cleaned quickly and efficiently with a sharp-edged tool sawed to the shape shown from a thick scrap piece of plexiglas or lucite. The cutting edge can be formed on a disk sander or beveled with a file.—E. L.

4 A HOT SHOT TO THE IGNITION will start a car on extremely cold mornings when oil is so stiff that most of the battery output is consumed in turning over the starter motor. The extra juice is furnished by four 1½-volt dry cells installed under the seat and connected through a two-way switch to the ignition circuit as shown in the drawing. Flip the switch to the ammeter side when the engine starts. A switch from the control panel of an old bus, if available, will provide spring action to close the storage-battery connection when the hot-shot battery is not held "on" by hand. Mount it on the dash.—L. C.





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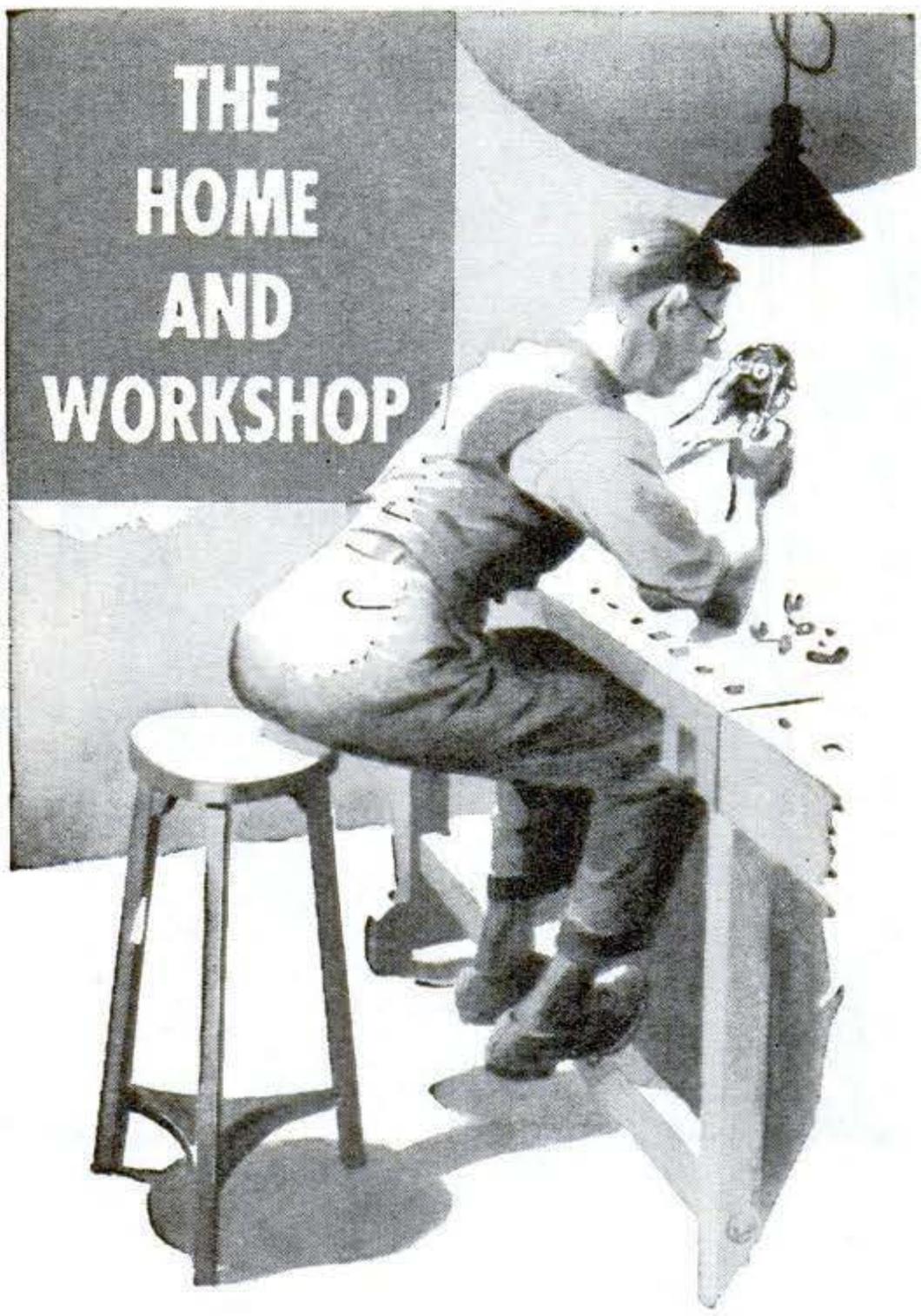
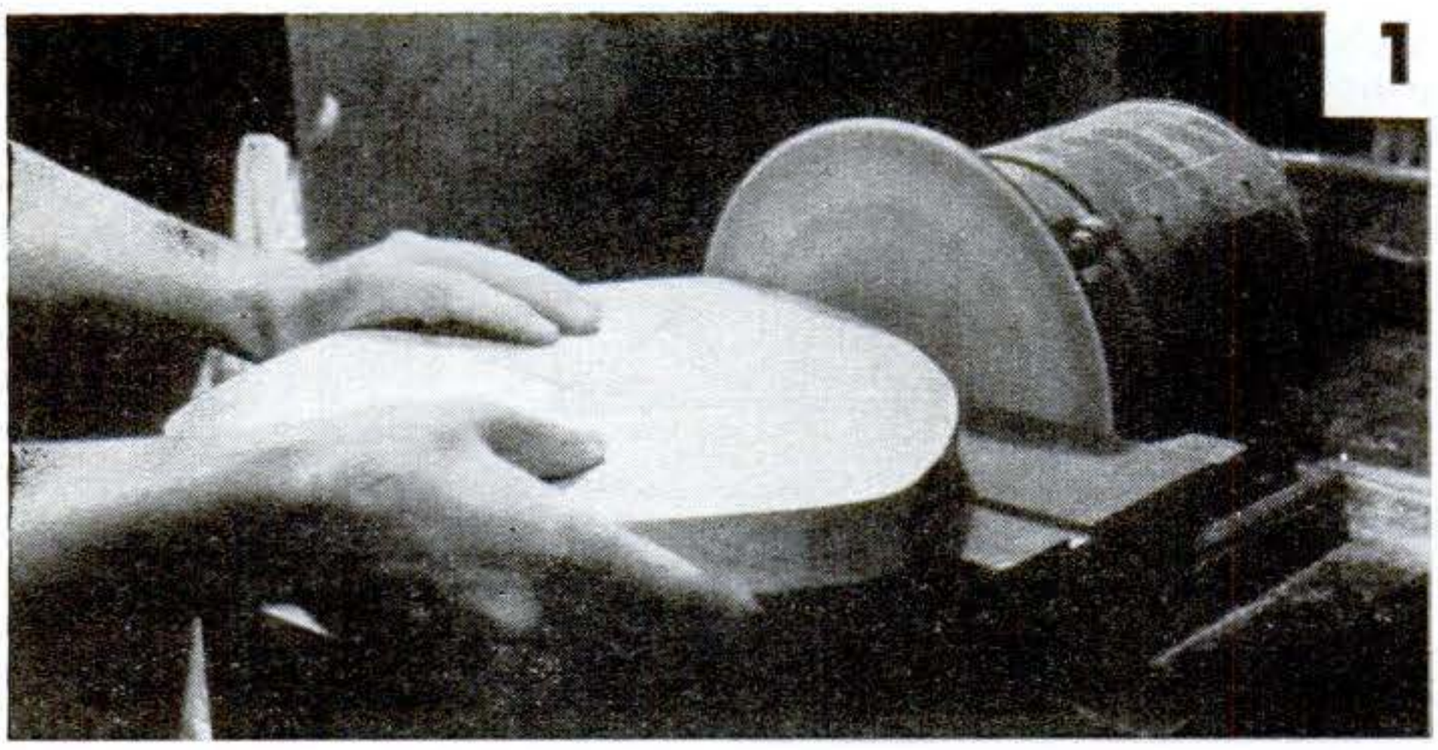


THREE-LEGGED

TWO MINDS may be better than one, but there are times when four legs are not as good as three. It long has been recognized that an object supported at three points—no more, no less—will rest firmly and evenly on an irregular surface. For that reason, this stool won't give annoyance by teetering on an uneven floor just when you're performing some exacting workshop task.

If you've been accustomed to riding your hobbies standing up, you'll find such a stool a restful surprise. There's no need to take the dimensions given as the last word. You may want to make the seat larger, or the legs longer or shorter, depending on the dimensions of your own.

The seat may split under strain if made of a single piece of solid stock. To forestall this, glue up two widths of 1⅛" stock with a dowel or spline joint, or glue two ⅝" thicknesses with the grain crossed to form a 1¼" piece. After you have laid out and bandsawed the seat to shape, sand it (Fig. 1), and bore ⅝" holes at an angle of 83 deg. (Fig. 2) for the dowels. If you haven't a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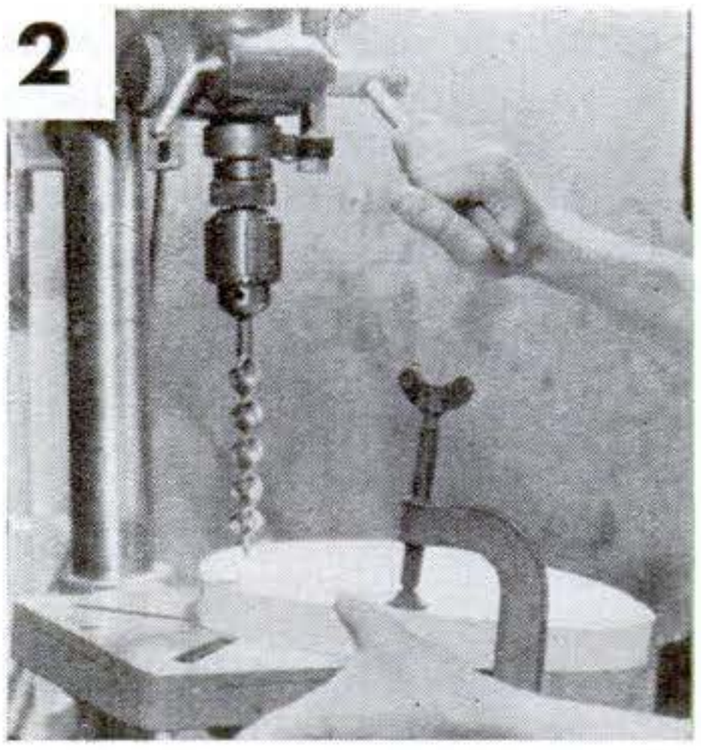
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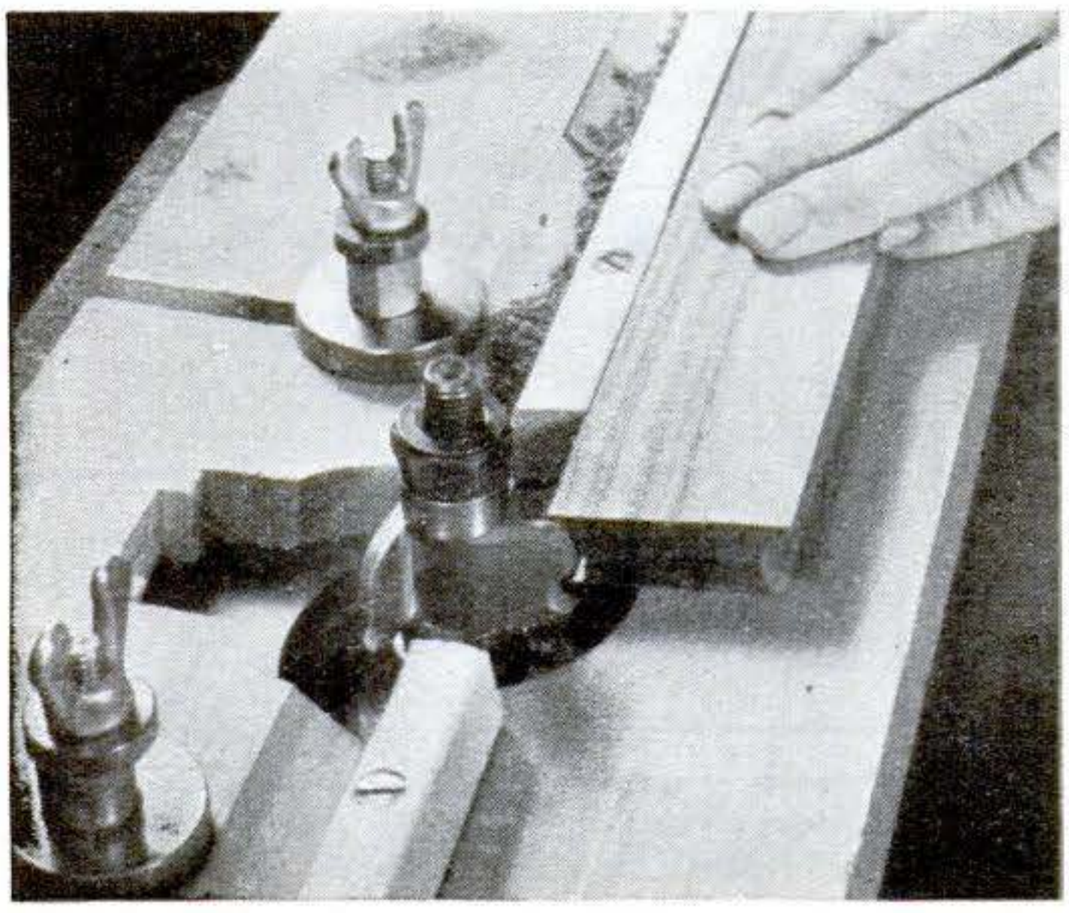

SPECIAL MOLDING ROUGHED

STOCK cutters that come as standard equipment with a small spindle shaper will only produce moldings that have profiles composed of straight lines or arcs of circles. But with a column jig such as the one shown here, the shaper also can be used to do the roughing when a molding with an elliptical or a freehand section is desired.

For moldings with a convex surface a straight cutter is mounted on the spindle. To set up for such a job, draw the profile of the molding on one end of the stock and adjust the tilt of the jig table so it will cut the edge on which the molding face is to be formed. Then make a single flat cut the

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SHOP STOOL CAN'T TEETER

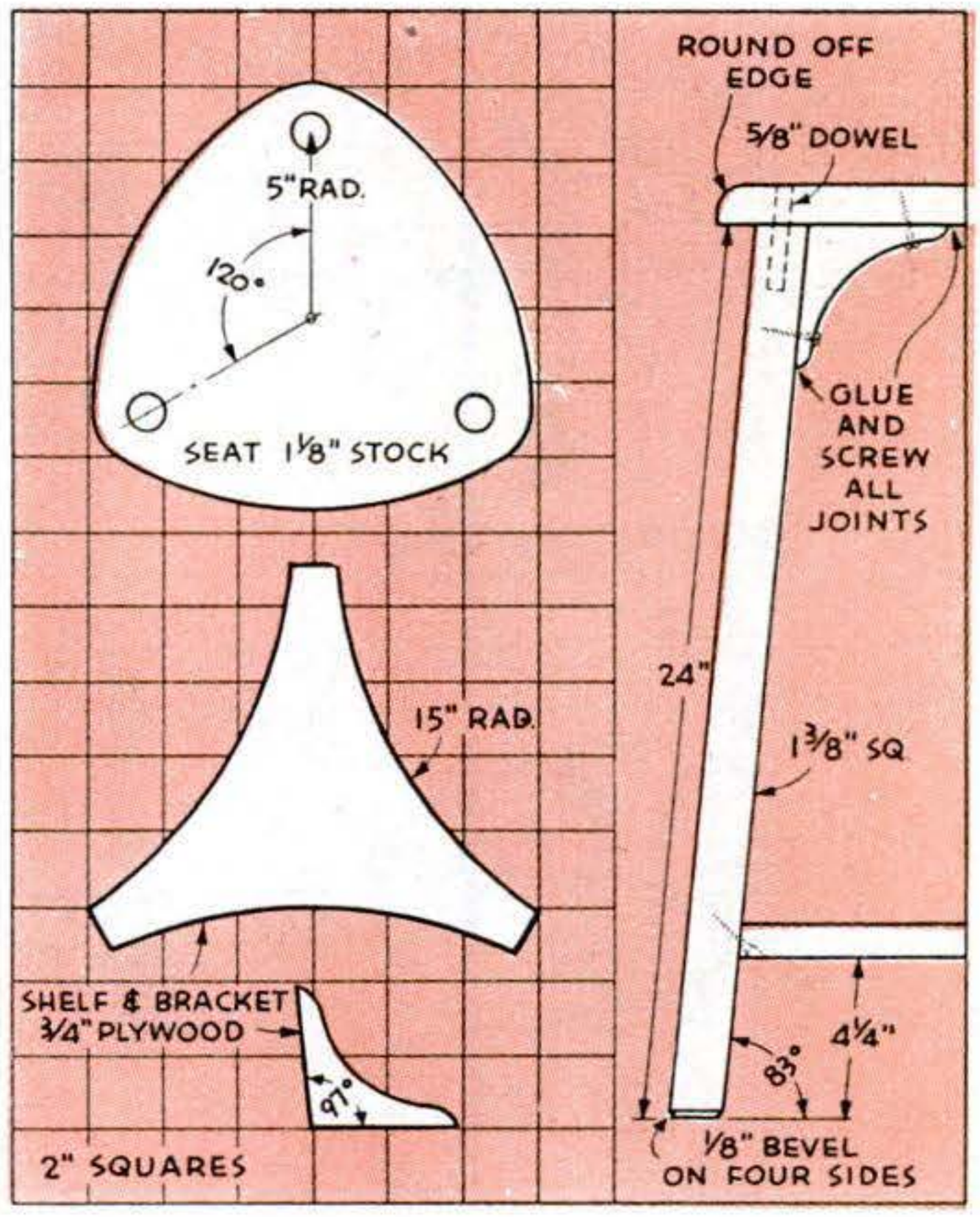
drill press, clamp on a thick block with a hole bored through at that angle to guide the bit.

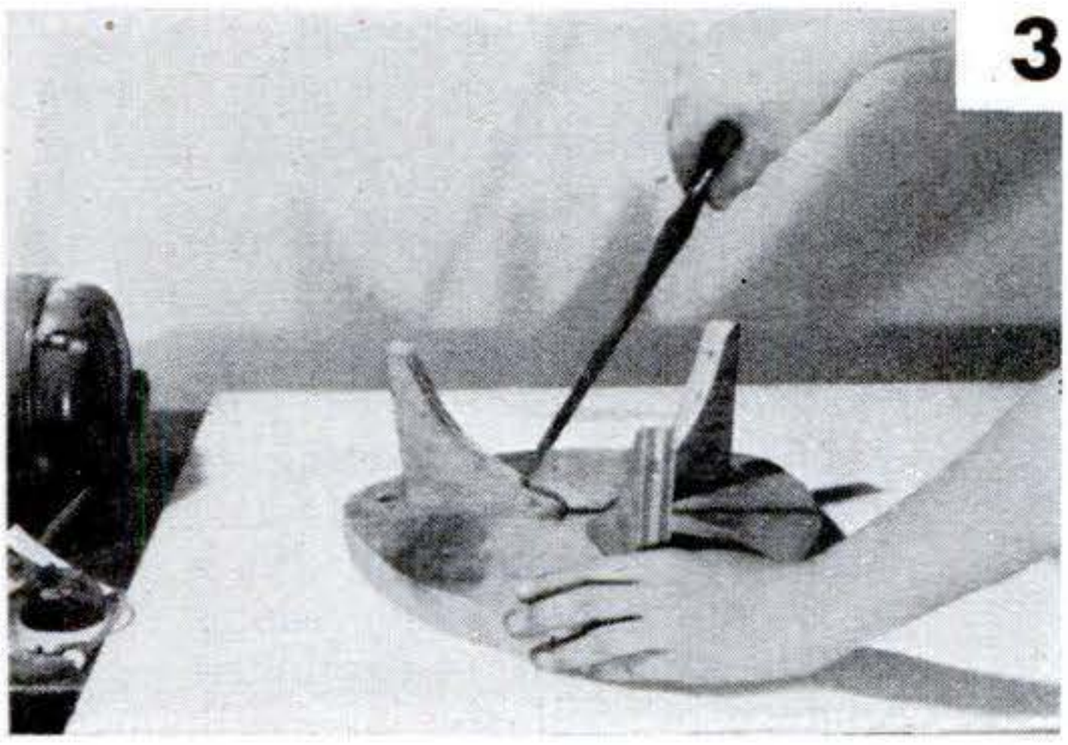
Lay out a pattern for the three plywood brackets. Then cut out and glue and screw them under the seat, as in Fig. 3, with their outer edges 4⅜" from the center.

Using a bevel square set at 83 deg., mark off the ends of the legs on 1⅜" square stock and cut them to length. When the glue holding the brackets has set, clamp a leg to each one in turn (Fig. 4) and bore through the seat to a depth of 1½" in the leg.

Plywood ¾" thick serves well for the shelf. It is best to cut it just a trifle oversize and trim the edges on a sander until a snug fit is obtained between the legs at the desired height. Fasten the shelf at each leg with glue and a single screw.

Round the top edge of the seat with a rasp and sandpaper, and sand the sharp corners of the legs. Then apply a primer or undercoat and hard enamel. And finally, keep the stool out of sight—your wife may need one in the kitchen.—H. W.

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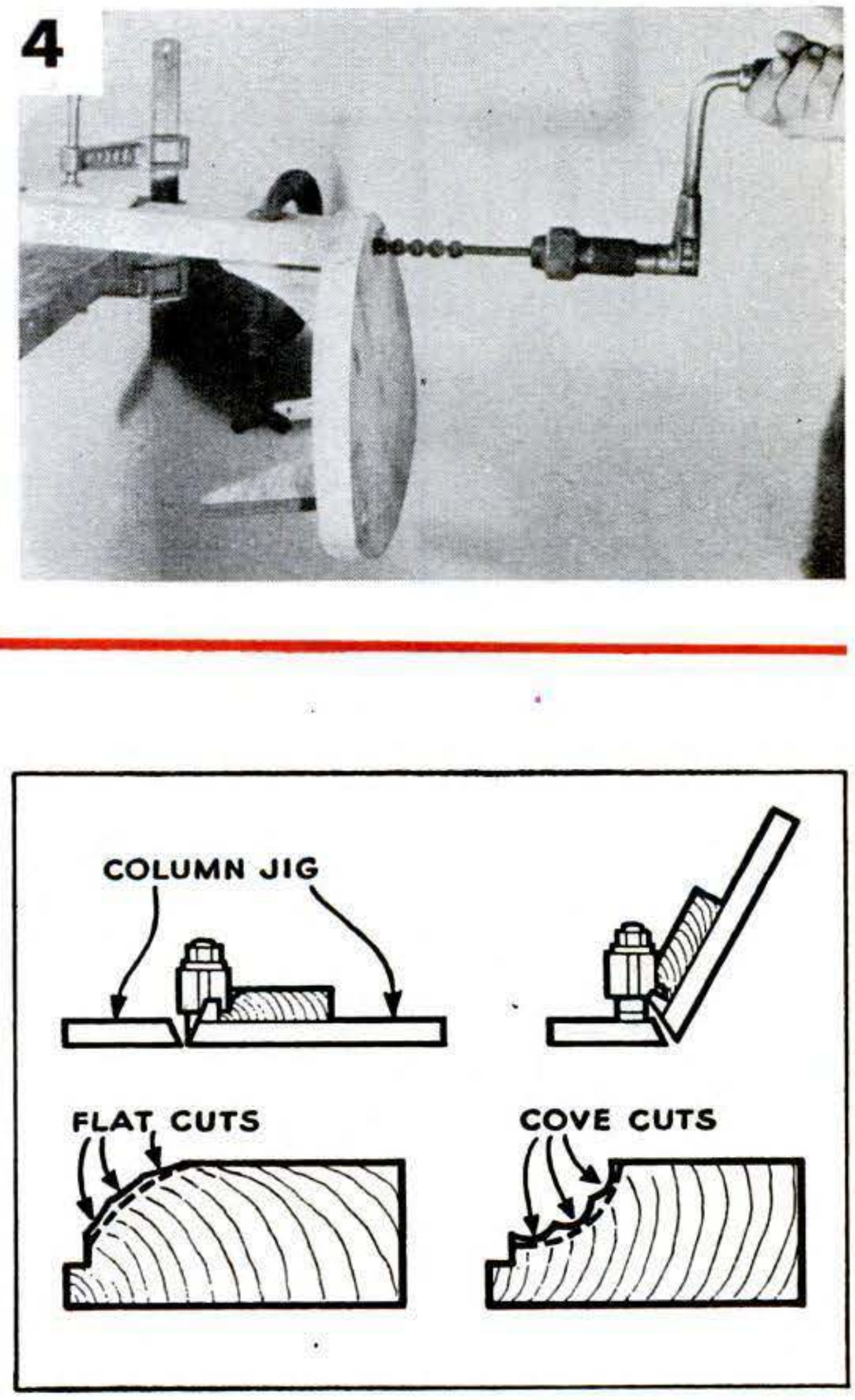
4

WITH JIG ON SMALL SHAPER

length of the stock. If more than one piece of molding is to be made, take this cut on all pieces before changing the tilt of the table. Then raise the table slightly and make second cuts on all pieces.

By repeating the operation and shifting the table and height of the cutter as required, a many-sided molding is formed, the curve approximation depending on the amount the table is tilted at each pass. The molding then can be smoothed with a scraper and a rounded sandpaper block.

Coves are cut in the same way, a curved cutter being used to make a series of scallops the length of the piece.—E. M. L.



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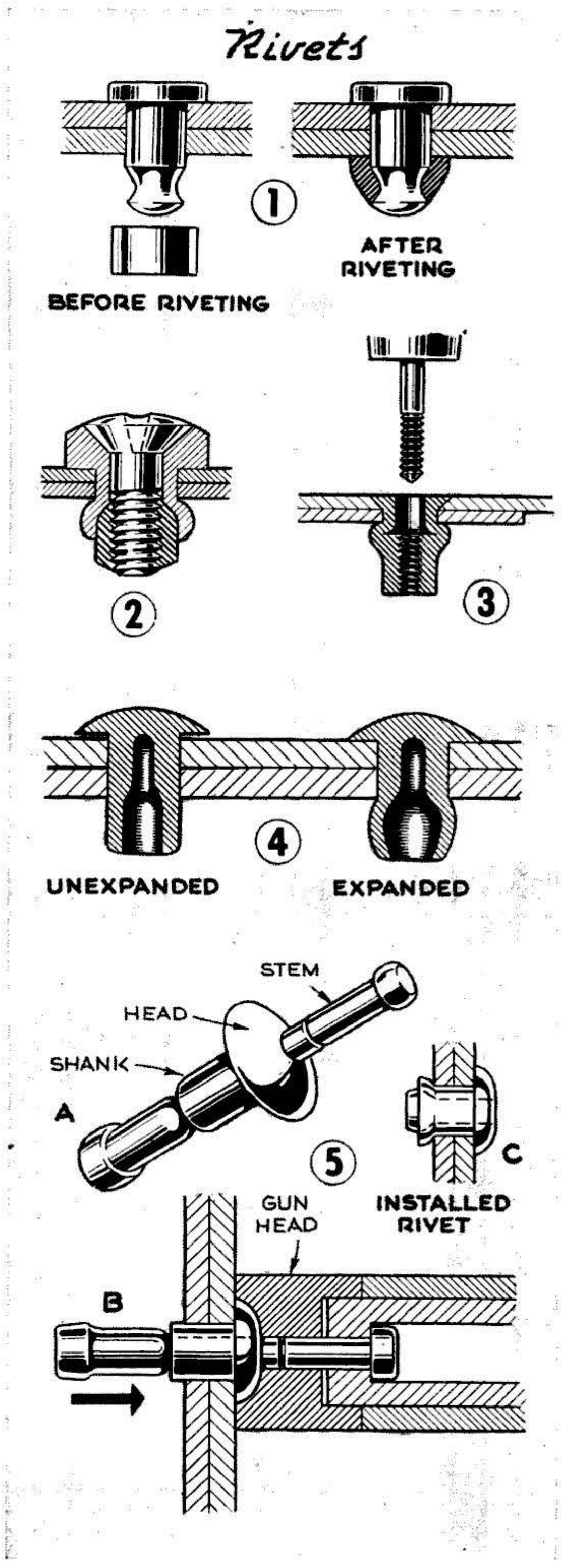
HOLD EVERYTHING!

By Walter E. Burton



REMEMBER the horseshoe nail for want of which a kingdom was lost? Craftsmen whose projects have been impaired through the failure of a screw or bolt, rivet or nut, will readily appreciate that crucial nail.

Many ingenious new fasteners were developed in war production, and many of the more familiar ones were modified for greater holding power or more convenience in use. Here's a descriptive summary of both old and new fasteners that may find their way into many home workshops.

RIVETS. Modern aircraft, which are in many cases literally sewed together by rivet stitches, have brought about a considerable development in special-purpose rivets. For example, in Fig. 1 (the Hi-Shear rivet) an alloy-steel rivet is anchored by an aluminum collar squeezed over it by a special tool. Great resistance to shearing stresses is said to result. The aluminum-alloy Preco rivet, Fig. 2, has for its core a steel bolt that engages a round nut. When the bolt is tightened, the nut expands the shank of this blind rivet.

Another ingenious blind rivet, the Rivinut, is shown in Fig. 3. Provided with a threaded core, it is first screwed on a special tool, placed in the rivet hole, and then upset by retracting the tool. The explosive rivet (Fig. 4) is probably the simplest of the blind types, though it may not have much scope for use in small shops. It is expanded by a small charge of explosive in the hollow shank.

Cherry rivets, shown at *A* in Fig. 5, are installed by means of a special heading tool or "gun", *B*, that retracts the core to form a tulip-shaped bulge on the blind side. The finished rivet *C* is available in both open and self-plugging types. Present marketing plans call for distribution in kits containing inexpensive heading tools and assorted rivets.

For the home shop, riveting is one of the easiest and most satisfactory ways of joining thin metal parts. Properly installed, rivets do not loosen easily, require little space, and can be removed when necessary without too much difficulty. Rivet holes should be barely larger than the rivets, and care must be taken to bring the work tightly together before heading the rivet. In addition to ordinary

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Here's a Fashion Parade of Fasteners for the Home Craftsman, Including Some of the Tricky New Ones Devised During the War.

rivets, a number of other types are useful, including split and hollow rivets, which are handy for work with leather and fabric, eyelets and grommets, and special tinner's and cooper's rivets.

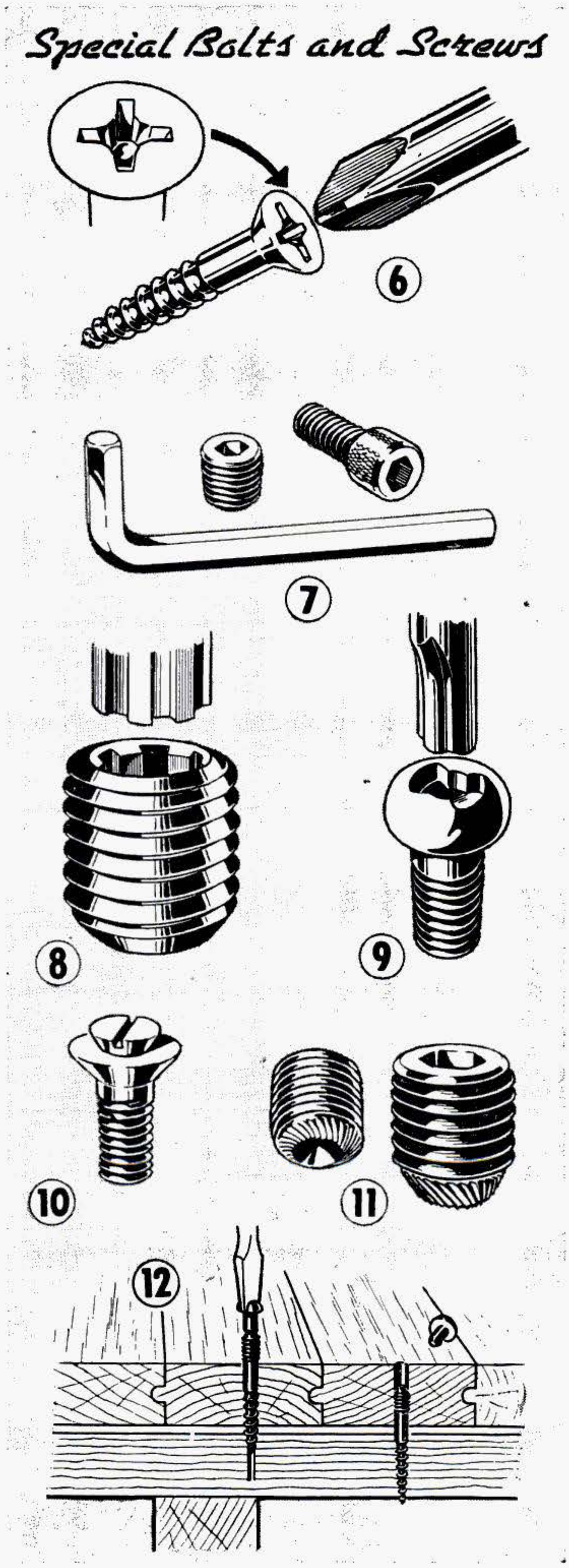
SPECIAL BOLTS AND SCREWS. The slot-head wood screw is often the target of complaints. Unless the screwdriver fits the slot properly, maximum turning force cannot be applied and sharp slivers of metal are thrown up, or the head may even split. Many special-head screws have been devised in an effort to correct these defects. The Phillips screw, Fig 6, uses a cross-shaped recess in place of the slot. Such screws are somewhat easier to start because the driver point centers itself, and the driver is less likely to slip.

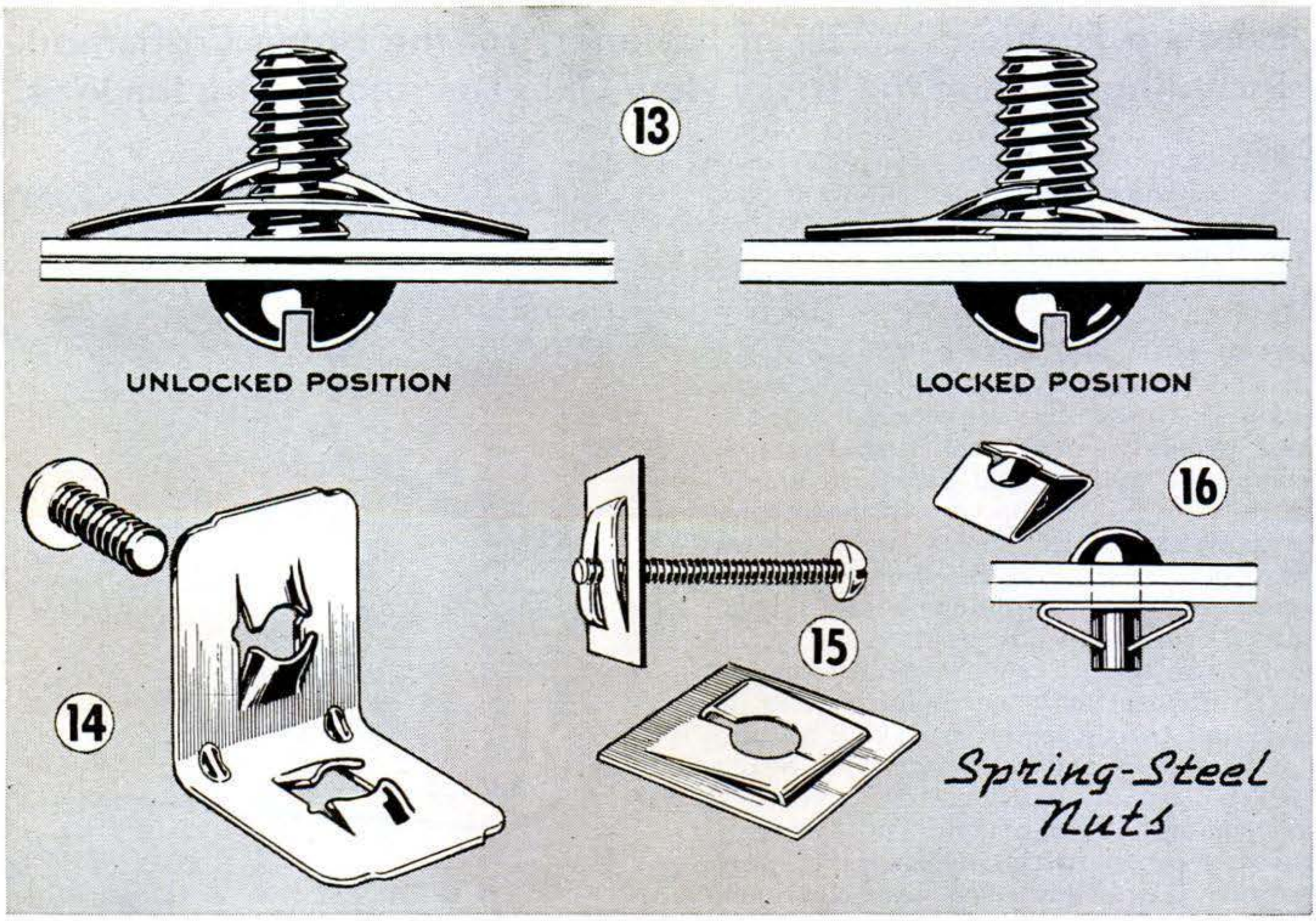
Cap screws and setscrews with heads recessed to take hexagonal-bar wrenches are coming into increasing use. They are favored by industrial designers in part because they require less head clearance than a bolt of equivalent strength that needs an outside wrench. The wrench recess can be considerably smaller than the threaded portion (Fig. 7).

Shown in Fig. 8 is the Bristo multiple-spline socket screw. Since the wrench tends to pull the screw around without the expansive, wedging action exerted by square or hexagonal wrenches in ordinary hollow-head screws, the screw will withstand a greater driving force without fracturing. Now that home motion-picture projectors and other equipment are being assembled with multiple-spline screws, many home repairmen will be adding the special wrenches required to their stock of tools.

The Clutch-Head screw, Fig. 9, has a recess in its head to take a special driving bit. When the tool is twisted backward slightly, the head of the screw is locked to the bit. This facilitates starting screws in hard-to-reach spots, a trick that will be appreciated by every craftsman. In a pinch, an ordinary screwdriver can also be used.

To baffle the burglar who might try to unscrew a lock or hinge, there is the ingenious screw shown in Fig. 10. After the screw is driven home, the outer slotted head can be broken off to leave a flush surface. For use where the ordinary setscrew fails to remain tight, there is the Unbrako screw, Fig. 11, which has a knurled point that bites into and locks on a shaft or other part. [*Turn the page.*]





An improved fastening device for the woodworker is the Wilson double-thread screw, Fig. 12. The shank has two threaded sections of different pitch, the finer one nearer the head. Differential action of the threads exerts a powerful force to pull the two pieces of wood together. The head may be broken off after driving and the hole plugged to make the screw invisible.

SPRING-STEEL NUTS. There's a growing family of nuts that don't look much like nuts at all. The Tinnerman Speed Nuts and Adel Stalock Fasteners (Figs. 13 and 15) are examples. This family even includes types (Fig. 16) that are used with pins or studs wholly devoid of threads.

The Tinnerman Speed Nut has numerous workshop applications — assembling radio and electric equipment, fastening brackets and components to panels, joining plastic parts, and securing porcelain-enameled materials. As the nut is tightened, the two prongs move inward to lock against the root of the thread, and compression of the arch creates a spring lock. This prevents vibratory loosening, yet is sufficiently resilient to prevent damage to plastic, glass, or porcelain enamel. Plans call for distributing these nuts through hardware stores.

They are also made in the shape of angle brackets (Fig. 14), in multiple combinations, and in U-shapes that fit over panel edges. Push-On speed nuts, Fig. 16, lock on unthreaded pins, rivets, or nails, and may be used for attaching name-plates, emblems, and trim.

The Adel Stalock Fastener (Fig. 15) grips the screw through almost 360 deg. The locking bridges are anchored at both ends, which is said to help them retain their locking power. Such fasteners can readily be reused.

LOCK NUTS AND WASHERS. Nut-locking ideas, born of war or improved during it, add security in applications where vibration is a problem. The Esna Lock Nut, Fig. 17, has a fiber collar that grips the bolt threads; for high-temperature use, the collar may be soft metal. Figure 18 shows two forms of a lock nut (Boots) in which the threads of two sections are normally a little out of phase. Tightening the bolt sets up a compressive action that holds it in place. The Huglock (Fig. 19) obtains its action through the slotted segments at the outer end of the nut, which press in against the bolt. Numerous other lock nuts working on these and similar principles have been developed.

Even the familiar split-ring lock washer shown at *A* in Fig. 20 has been modified for greater holding power. Shown at *B* is a type having a rib on its inner edge that wedges itself into the nut chamfer and bolt thread. The kind shown at *C* is made of spring steel and holds entirely by reactive tension, with-

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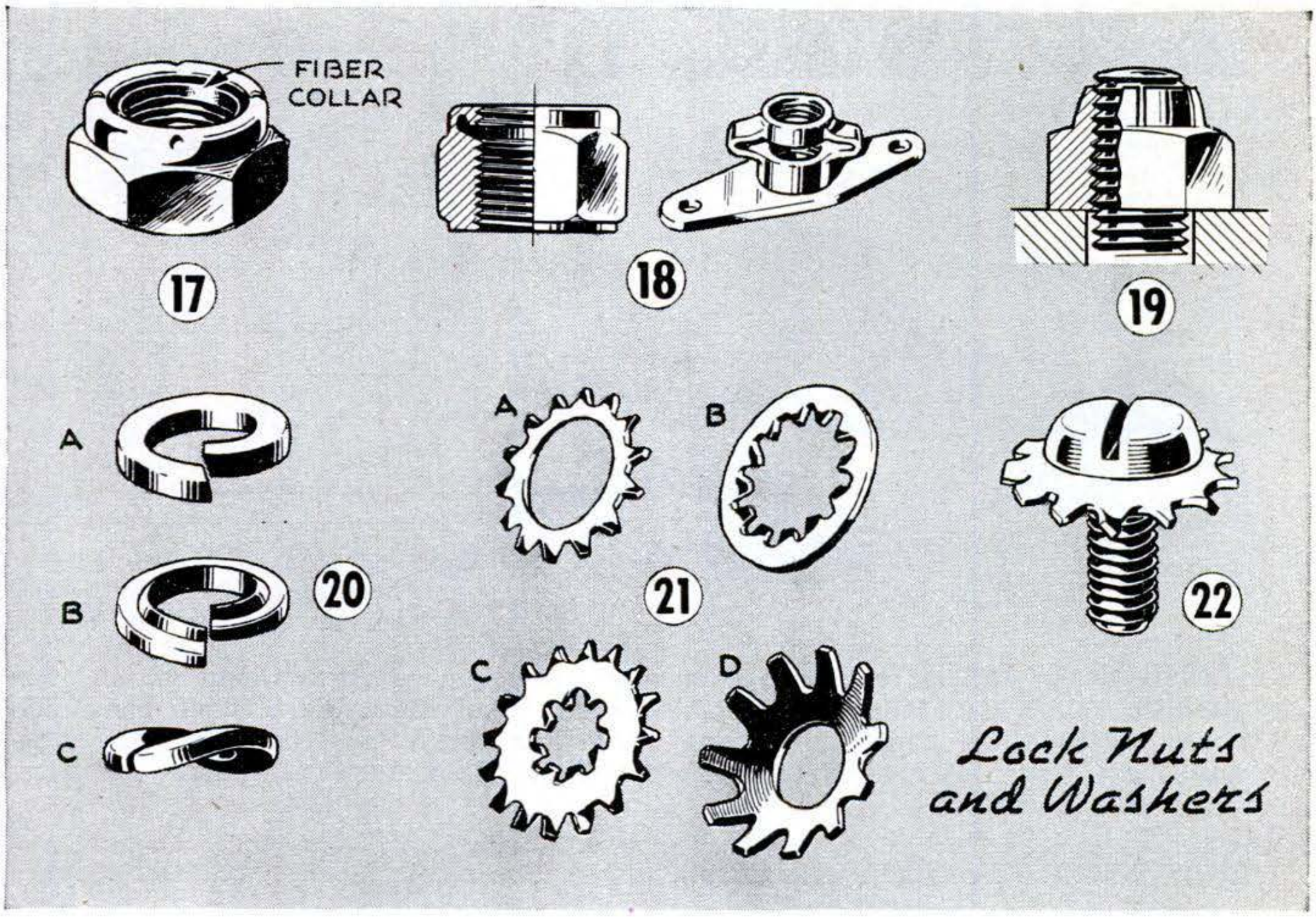


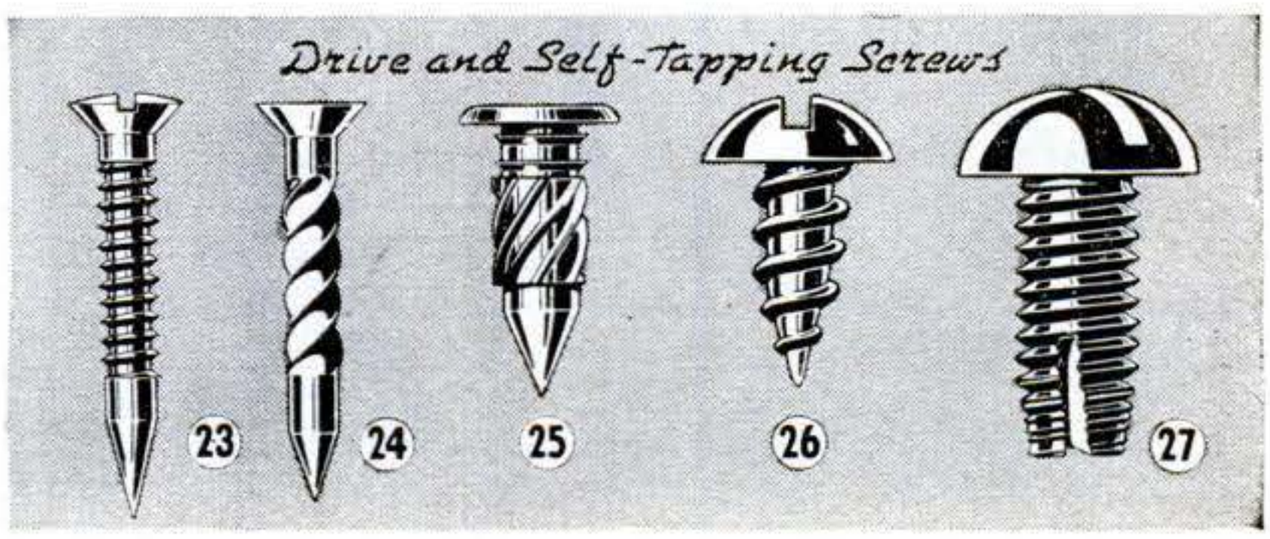
out digging into the surface that is bolted.

Toothed lock washers are handy in the shop, particularly in electrical and radio work. Four common types (Shakeproof) are shown in Fig. 21: *A* is an external-tooth type used with hex or square nuts, and with certain screws, while *B* is an internal-tooth variety for fillister-head and hex-head screws. A washer having both external and internal teeth, *C*, may be used over oversize holes, on hardened surfaces, and on materials such as wood or plastic. The dome-shaped external type at *D* is designed for flathead or oval-head screws. In all of these washers the teeth are both tapered and twisted. It is said that vibration, by making the teeth bite more deeply, actually increases the locking action.

Figure 22 shows the Sems Fastener, a preassembled unit consisting of a screw and nonremovable toothed lock washer. While designed for war production, it would be useful where a vital lock washer might be accidentally omitted during reassembly.

DRIVE AND SELF-TAPPING SCREWS. A cross between a screw and a nail, the drive screw combines the simplicity of a nail with the holding power of a screw. There are numerous kinds. The one shown in Fig. 23 is for fastening sheet metal to wood; it is driven through the metal with a hammer blow, and is then turned home with a screwdriver. A common drive screw for use in wood is shown in Fig. 24, while a special one for attaching leather or cardboard to wood is pictured in Fig. 25. Somewhat similar ones are used for permanent fastenings in forgings, castings, plastics, and heavy-gauge sheet metal. In hard materials a lead hole is usually required.

Self-tapping screws have threads more like those on conventional screws and are driven home by screwdrivers or special bits. The type having continuous threads (Fig. 26) forms rather than cuts the pilot hole to fit. Such screws are used in sheet metal, nonferrous castings, plastics, and composition materials. For tougher going, there are self-tapping screws having thread interruptions that form cutting edges like those on a regular tap, as in Fig. 27.



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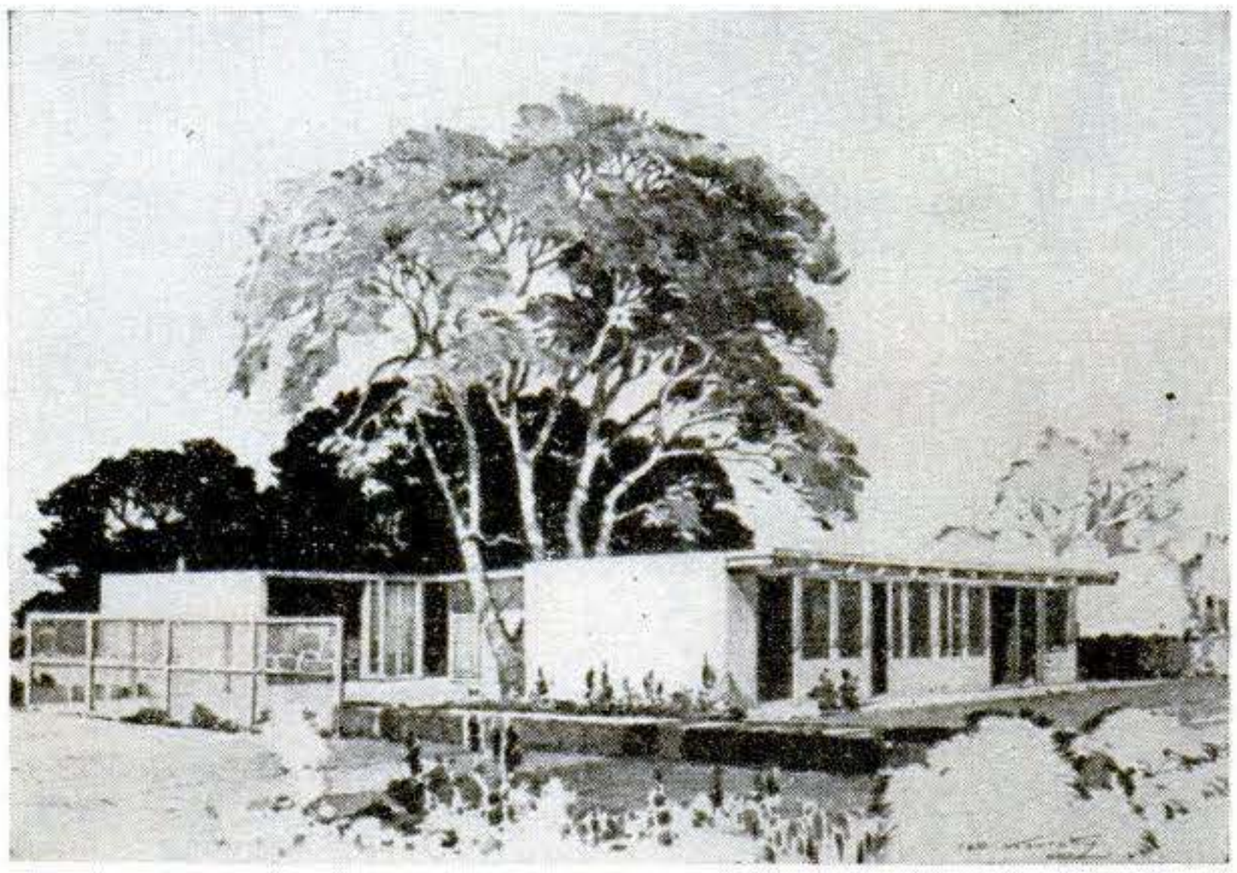
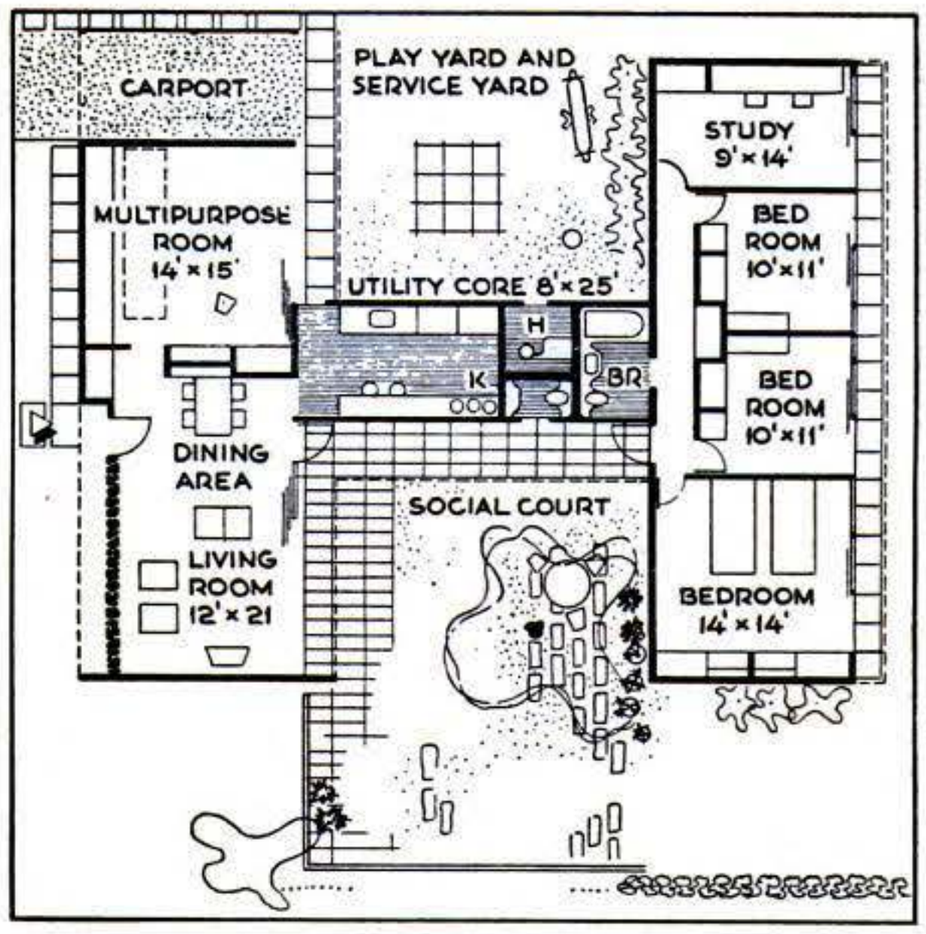
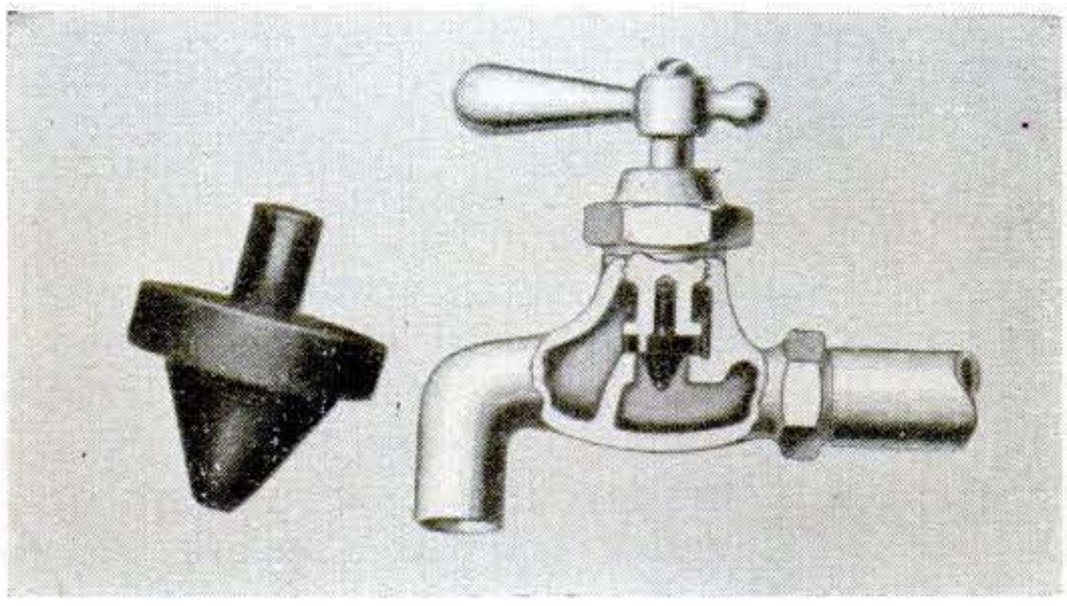
HOME OWNERS



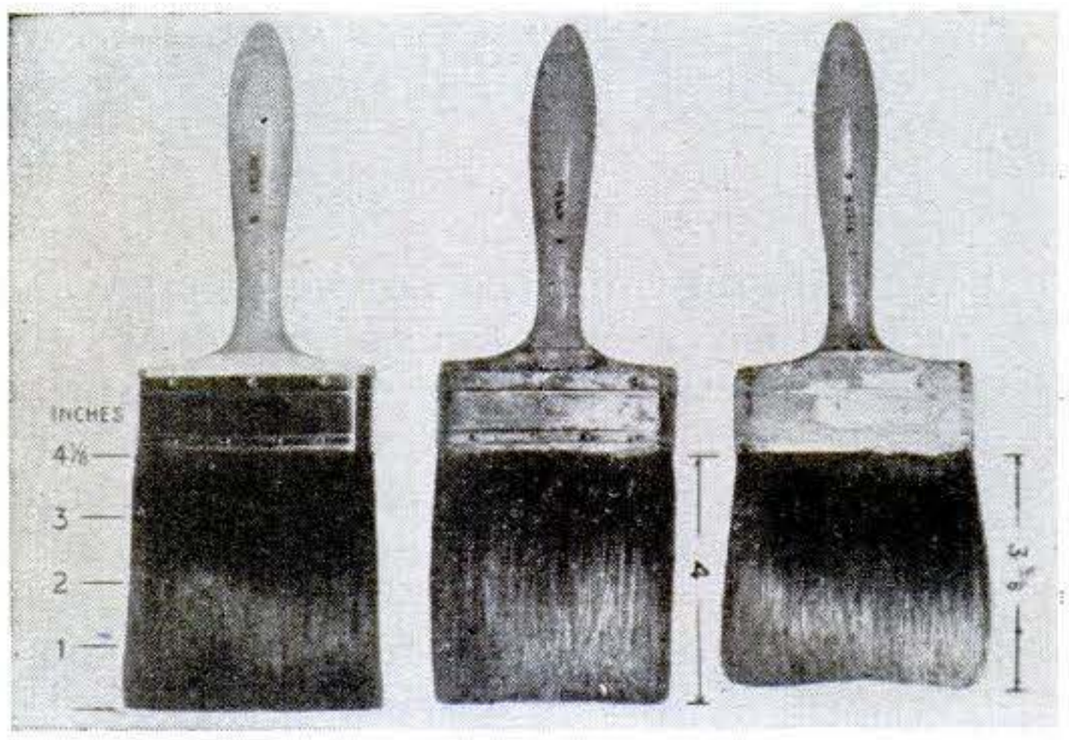


Open courts in addition to front and side yards help to give a sense of outdoors. The two wings of the house flank a utility core.

LIVING IN GLASS is receiving increasing attention. Here are a sketch and plan of a house using glass generously along the walls. The design, by Mr. and Mrs. Norman Fletcher, of Birmingham, Mich., won first prize of $2,500 in a contest sponsored by the Pittsburgh Plate Glass Company. The house was planned for California.



NEW WASHERS are available for repairing dripping faucets without use of the customary screws. They are resilient enough to fit any faucet seat snugly regardless of wear and are manufactured in three popular sizes. Durst Manufacturing Company, Inc., of New York, is the maker.



TESTS ON NYLON PAINTBRUSHES conducted by 20 painters in as many sections of the country produced results like those shown above. One nylon-bristled brush, according to the Du Pont Plastics Bulletin, was still in good condition after 2,450 hours use. At left in the photo is a new tapered nylon paintbrush; at center, a brush used on 40,000 sq. ft. of surface; and at right, one used for 75,000 sq. ft.

SHOVELING ISN'T NEEDED by Joseph C. Keaney, of South Hills, Pa., to keep his driveway clear. He embedded two 1¼" wrought-iron pipe lines under the driveway and attached them to an instantaneous hot-water heater in his garage. The result is that a ½" ice coating can be melted in 20 minutes or a 15" snowfall in two hours. Antifreeze keeps the water in the pipes from freezing when the heat is off.

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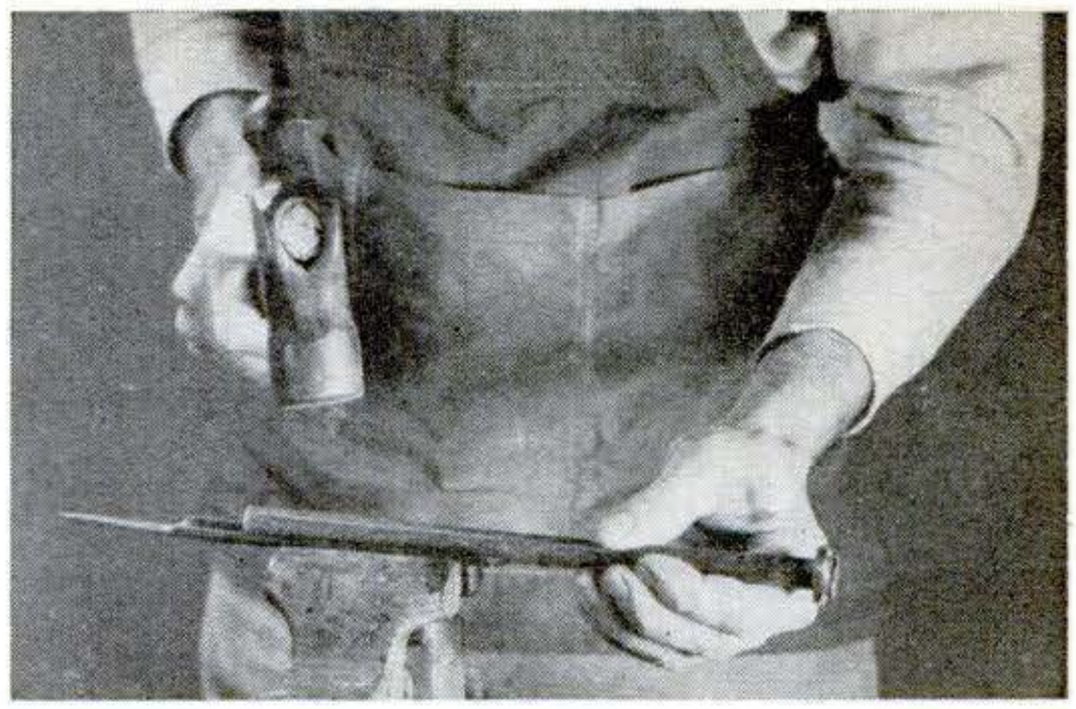
FORGE YOUR OWN CARVING CHISELS

FLAT files and umbrella ribs afford excellent steel for making both small and large carving chisels. They can be heated for forging with a blowtorch set up to blast into a small pocket or oven of loose stones or bricks. As a jig for hollowing gouges, clamp a piece of angle iron in a vise or support it in a groove cut in a block of wood.

To make a gouge (Nos. 7, 8, and 9) break off a file near the bottom of the end taper, heat it red, and lay it in the angle iron. Beat along the center with a ball-peen or cross-peen hammer; then deepen the hollow with a round iron rod hammered in, reheating as necessary to keep the temperature up to redness. Finish hollowing in the vise with the jaws open almost enough to let the file slip between.

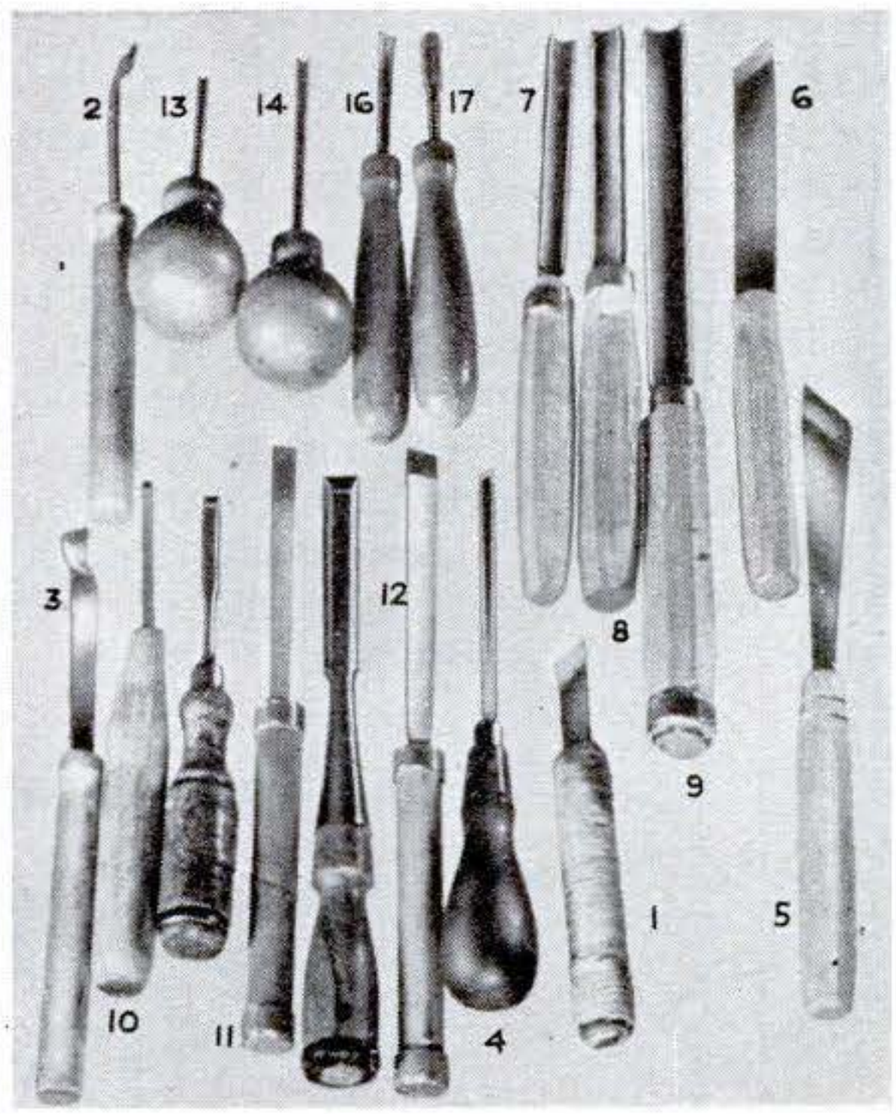
Sharpen the tip of a cone skew (Nos. 5 and 6) to a point first, and then bend the end over the edge of the vise, rolling it into a cone. The angle may be about 75 deg. before rolling. One tool is right-handed, the other left. Spoon skews, Nos. 2 and 3, also identical except for right- and left-hand angles, are hot-bent with pliers.

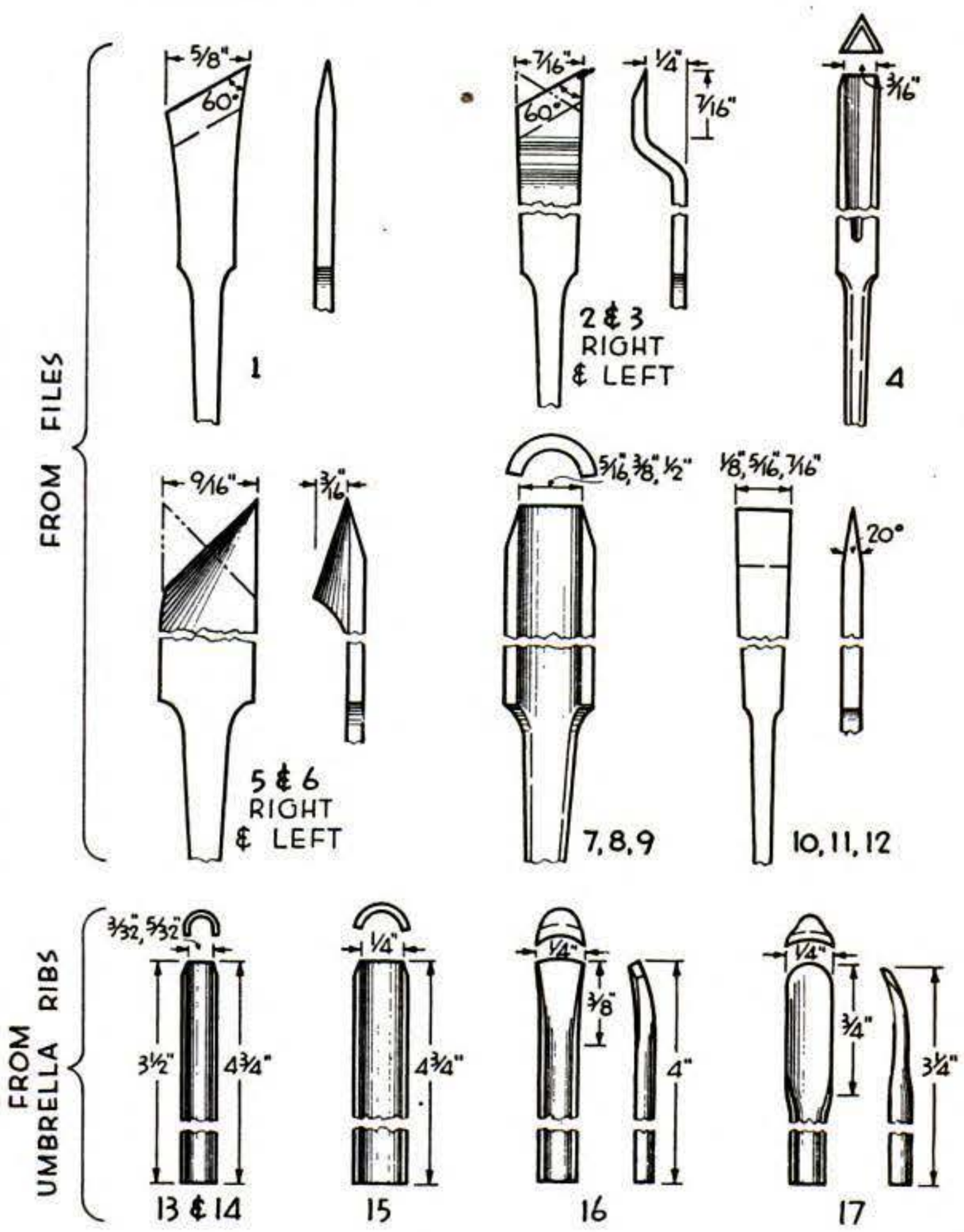


The gouge rests on vise jaws while being hollowed.

File a groove in one face of a three-cornered file for the veining tool, No. 4, after drawing the temper, and file the bottom edge sharp. Flat chisels can be ground cold without first drawing the temper. Umbrella ribs, their temper drawn, are opened up for small gouges, No. 13, 14, and 15, or flattened and bent for Nos. 16 and 17.

Rough-grind cutting edges before rehardening and tempering to a straw color. Sharpen gouges square across and beveled outside, spoon skews beveled from the back, and skew knives and flat chisels beveled on both sides. Grind the teeth off inside gouges and unbeveled faces.—E. M. L.





Homemade except for two socket-firmer chisels (unnumbered), the tools shown above make up a good wood-carving kit. The small gouge, No. 15, may be added. Mill files 4" to 8" were used except for No. 4, which required a triangular file, and No. 10, a 4" square file. Two sizes of umbrella ribs were used.

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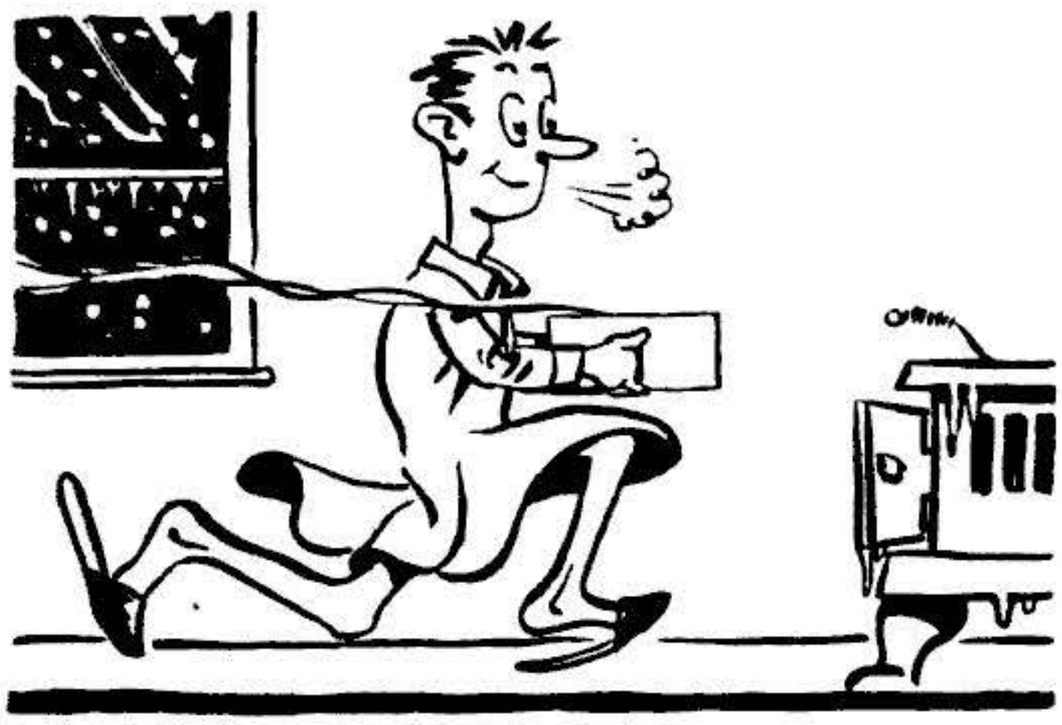
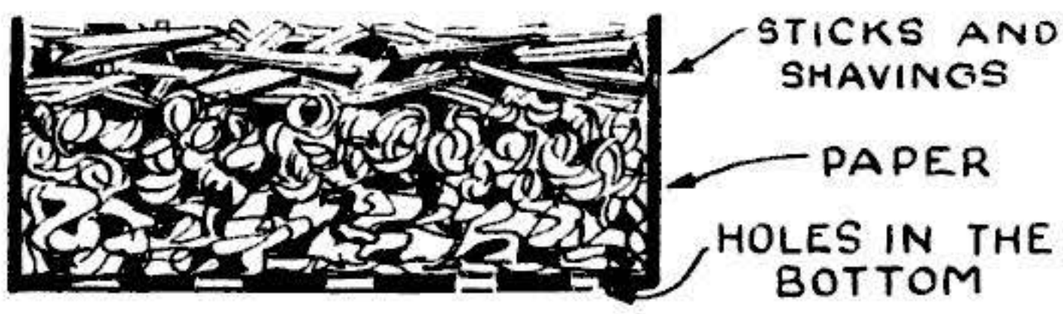
WHAT'S YOUR INGENUITY QUOTIENT?

Have you pulled off a smart one lately? We will pay for each contribution accepted for this page showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.





AN ESKIMO I'M NOT, so I don't relish shivering on chill mornings while nursing my cottage stove into life. To keep my corpuscles from congealing, I fixed up a stack of portable prelaid fires—cardboard boxes with draft holes, paper, and wood shavings.

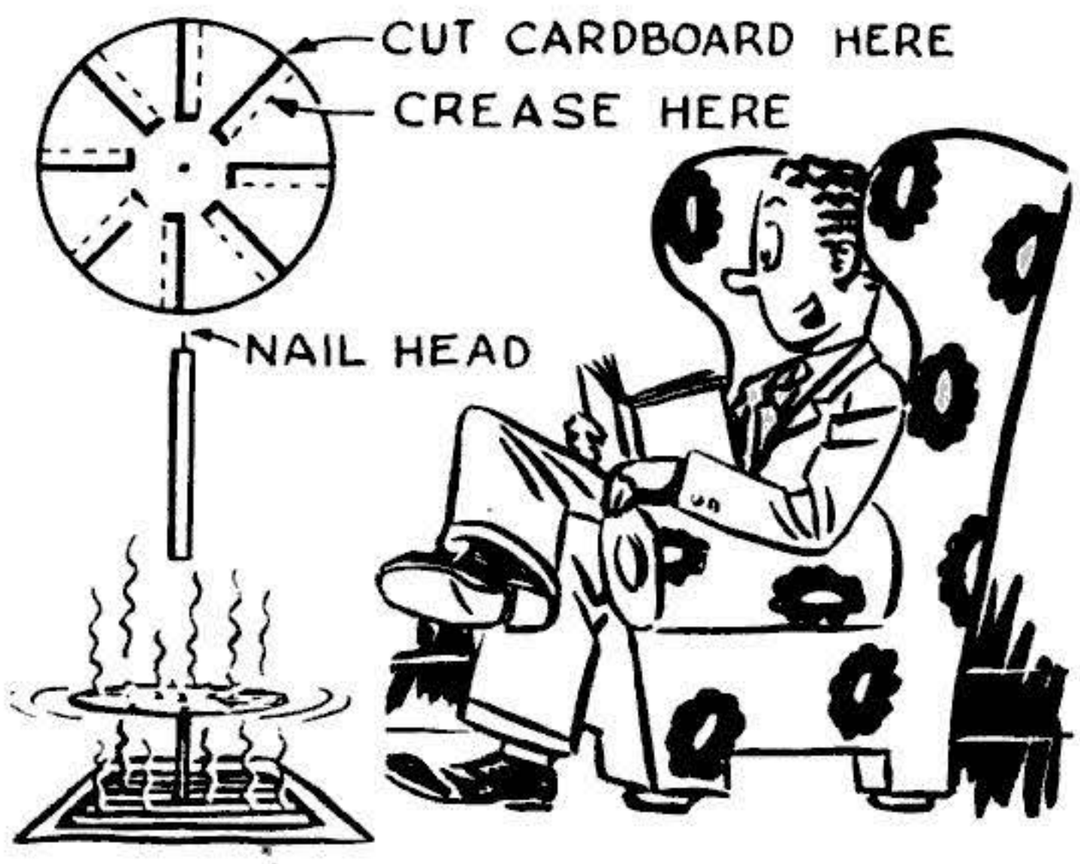
I apply a match to the crumpled paper through one of the bottom holes, place the carton in the firebox of my stove, and let nature take its course. In no time at all I have a blazing blaze.—A. P. YOUNG.

FLOWERS CAN'T TELL when they need sunlight except by withering away. Potted plants need sunlight all around, but mine didn't get it until I thought of lettering a weekly calendar around the base and an arrow on the window shelf. As I give my plants their daily watering and attention, I turn the pot until the current day faces the marker. All sides thus get equal exposure to sun and air, and benefit accordingly.—BERTRAM BROWNOLD.

GABRIEL, KEEP THAT TRUMPET QUIET! If that well-known horn blower has this trick in his toga, sound sleepers won't answer reveille on judgment day.

Finding that good mutes weren't to be had at my price, I appropriated an empty powder container and cemented three strips of corrugated cardboard at equal distances about a third of the way from the top. A few dashes of paint in an appropriate design made it the snootiest mute that I have ever tootled into.—EUGENE A. REESE.

HOT ENOUGH FOR YOU? That's a question people ask me all summer and I ask myself all winter. Now, however, I don't have to look far for an answer. When lolling at ease in my armchair, I can tell how my hot-air furnace is behaving by glancing at this circular propeller. A cardboard disk, about 15" in diameter, cut into segments as shown below, whirls at a rate proportional to furnace heat. The shaft consists of a dowel wedged into the grating of a strategic hot-air register.—FRANCIS FAGAN.



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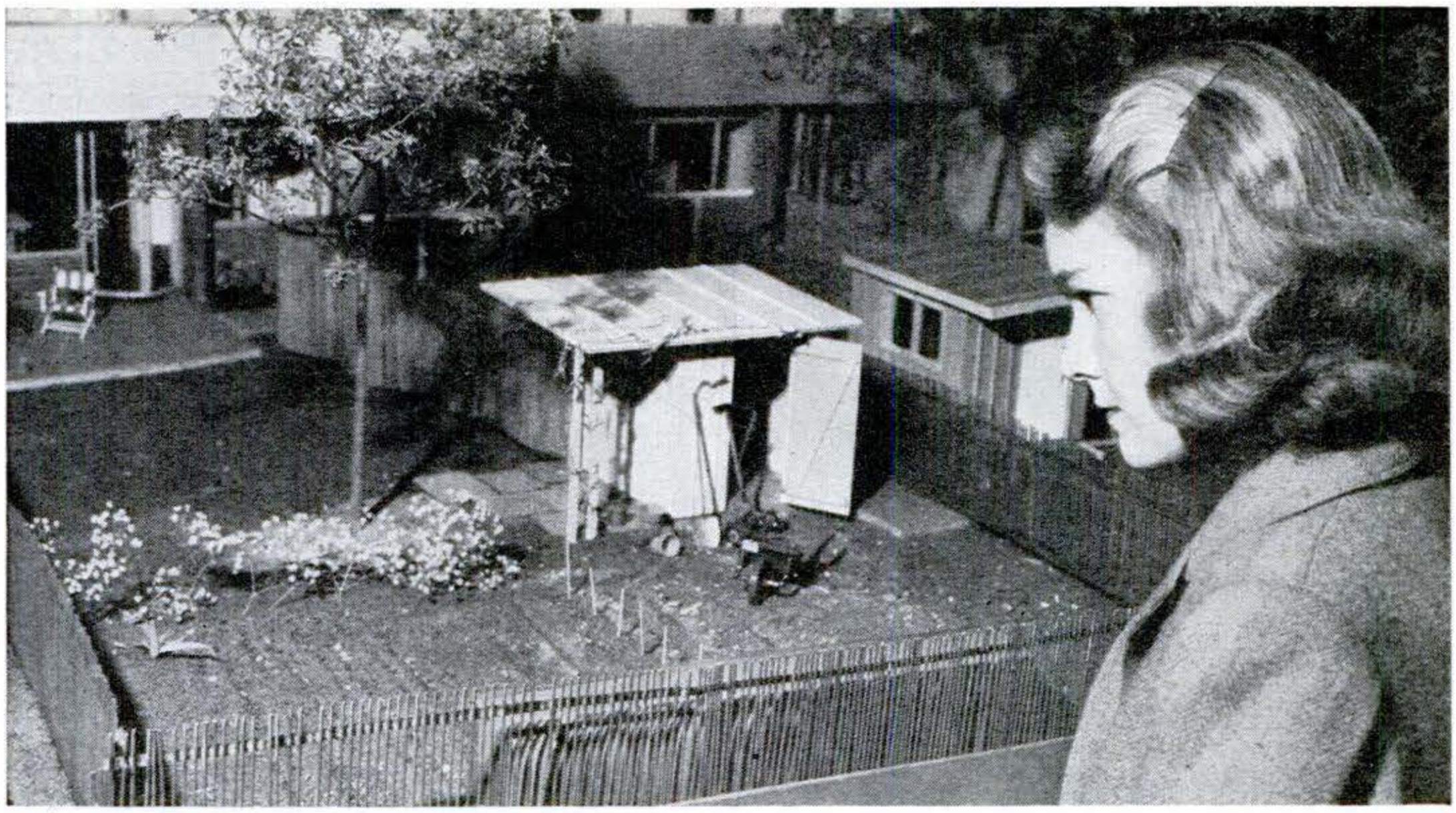
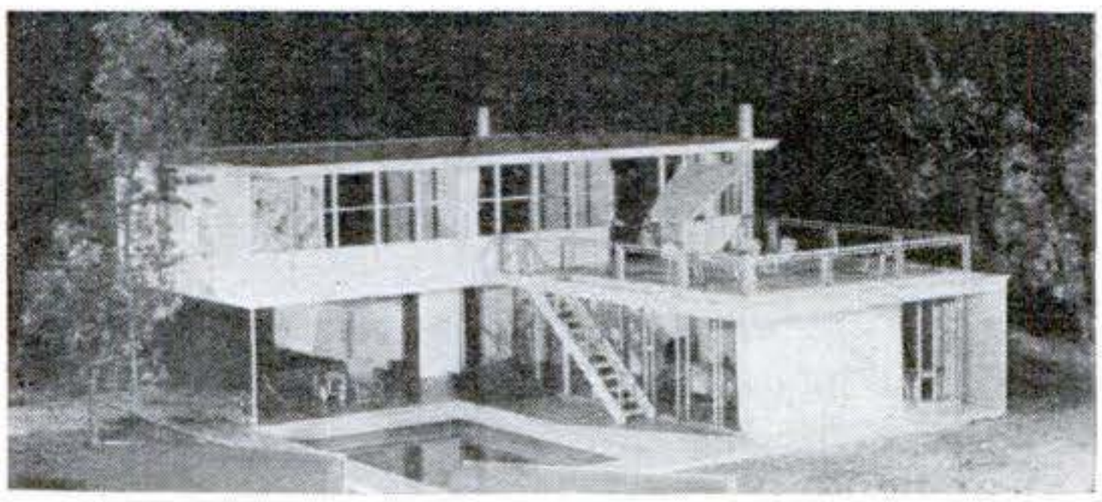


Architects display their new home designs with models. Even furniture and garden tools are built to scale.

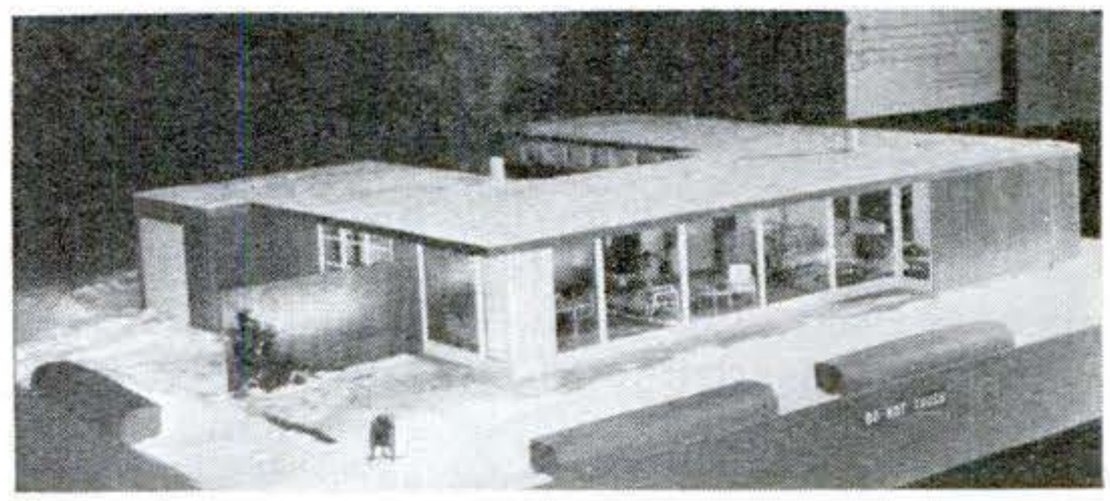
Model Housing Accents Modern Family Life

WITH emphasis on the family, a group of well-known American architects showed these scale-model homes, all designed to meet the needs of those having two to four children and an income of from $2,000 to $3,000 a year. Each home contains three bedrooms, ample living and dining space, a modern kitchen and laundry, plenty of closets, and a garage with room for a workshop and storage. Construction is on a concrete floor slab without a cellar.

The faithfully executed models were exhibited at the New York Museum of Modern Art. Furniture and accessories are to scale.



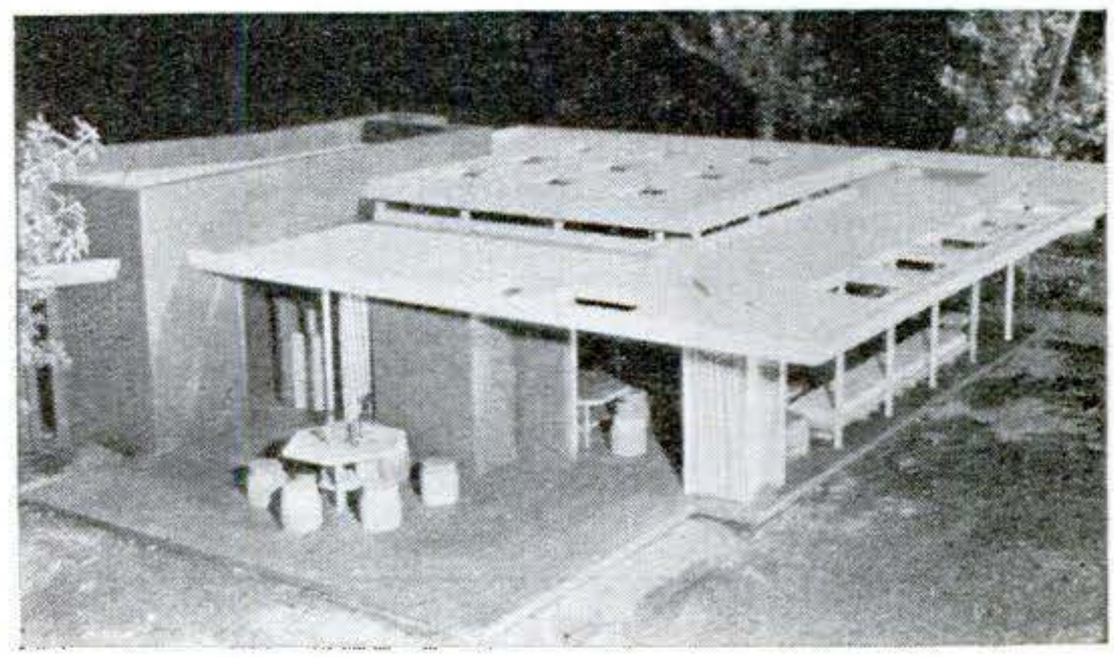
House, garden, and pool on a city lot. The upper story runs in one direction, the lower in another.



This U-shaped home has a wing of bedrooms and one of service rooms. The living room connects them.

Below is an idea for a row of houses that will be similar without looking exactly alike. A sun deck on one shelters a terrace beside the garage below.

Full-length glass windows face south in the home below to catch the low winter sun, while the deep eaves shade them when the sun is high in summer.



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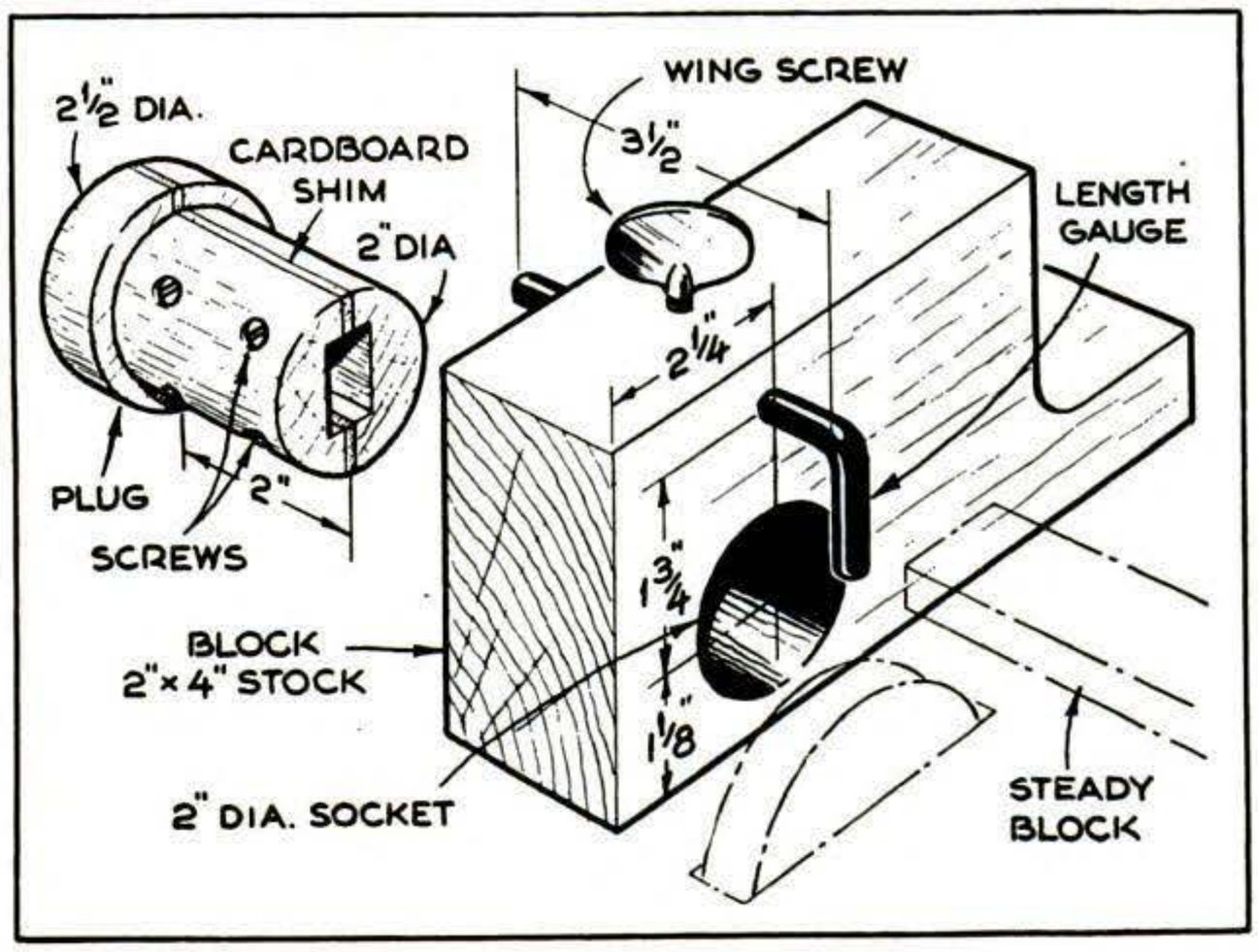
Round Tenons Are Quickly Cut with Revolving Jig and Dado Saw



USED with a dado saw, this jig provides a quick and accurate way of cutting round tenons on wooden rods. It consists of a block of wood pierced by a circular socket in which a plug, turned to a sliding fit, revolves while holding the work. A bent rod through the block serves as a length gauge.

Cut a hole through the plug to fit the piece to be tenoned, locating it so that the tenon, not necessarily the rod, will be concentric with the plug itself. That is, if the tenon is to be off center, make the hole correspondingly off center to keep the tenon concentric, or if the tenon makes an angle with the center of the rod, incline the hole with the axis of the plug. The holes are more easily cut by sawing the plug in half, and then reassembling with cardboard between to make up for the saw kerf. Plugs once made should be filed away for future use.

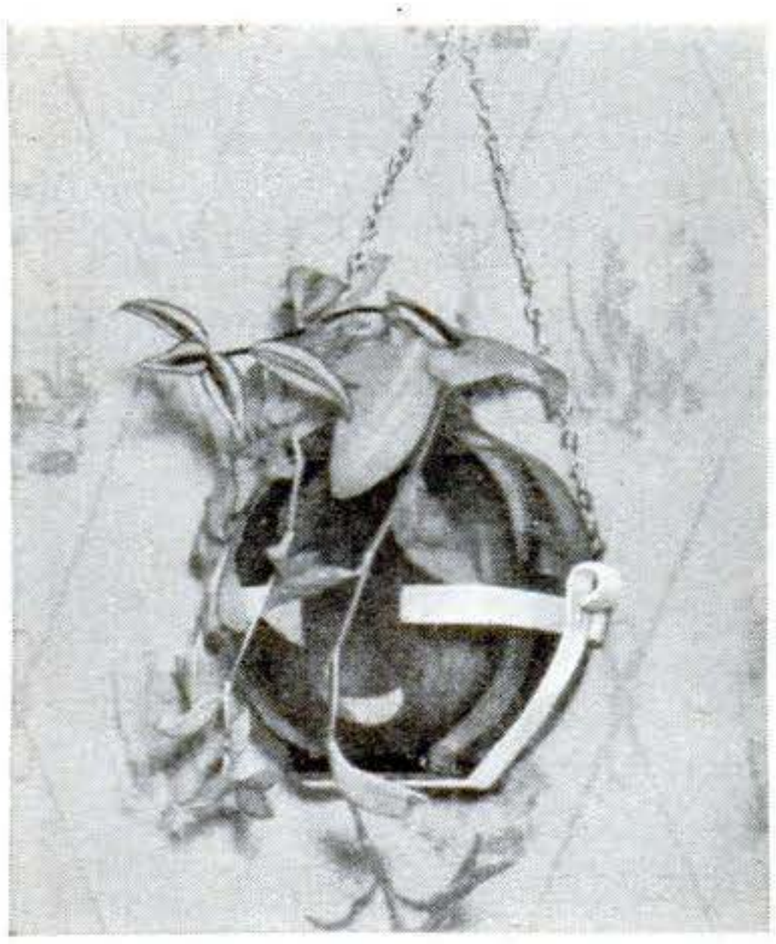
To use the jig, clamp the block parallel to the dado head, adjust the length gauge and the depth of cut of the saw, and insert the work in the plug. As you enter the plug in the socket, rotate it opposite to the saw, spiraling the cut until the plug shoulder comes into contact with the block.—E. M. L.

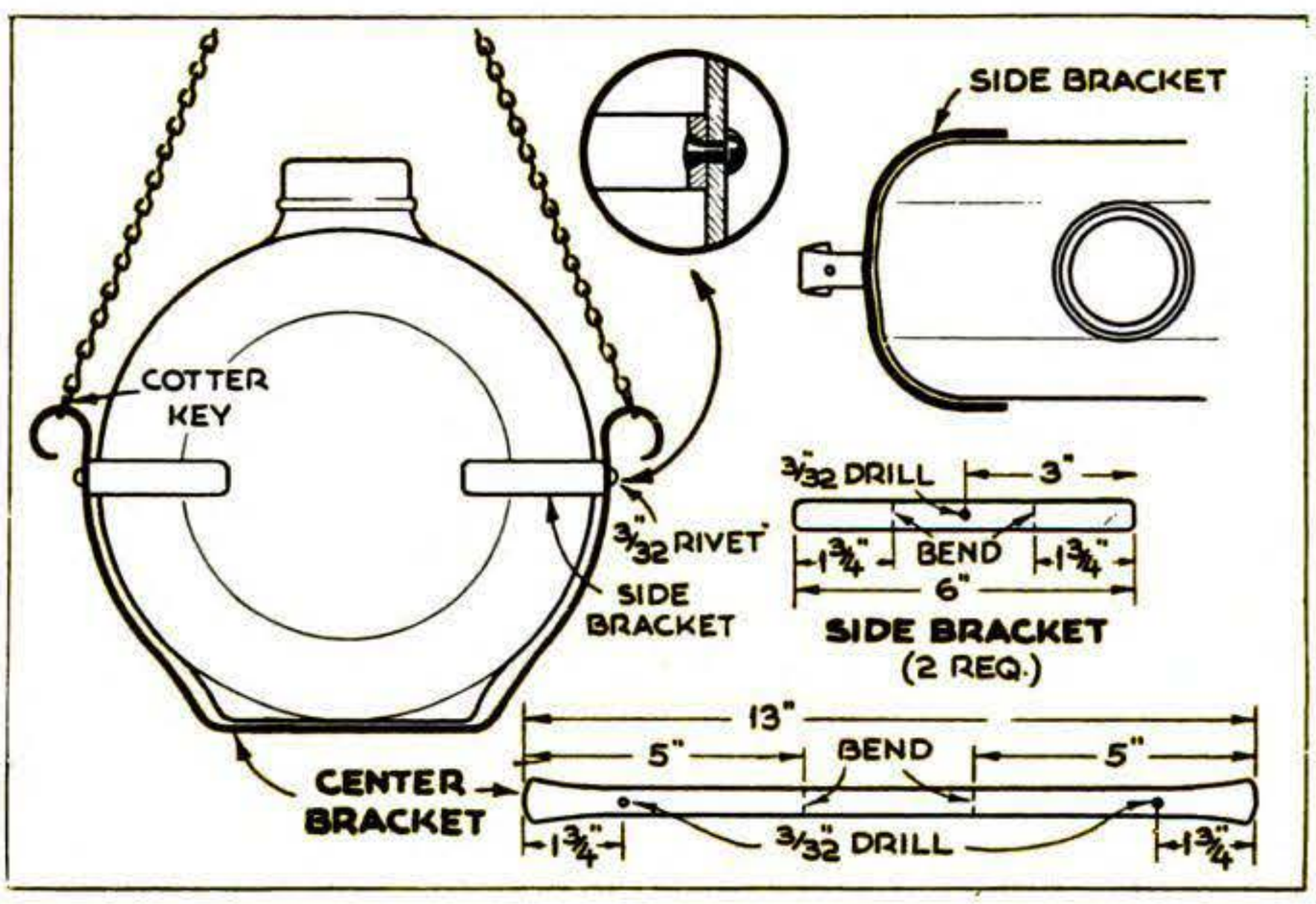
Decorative Bracket Puts Prune-Juice Bottle to Work as Ivy Jar

SUSPENDED in this bracket, an ordinary prune-juice bottle becomes an attractive ivy jar. In addition to the bottle, the materials required are a piece of band iron, two roundhead rivets, two key chains, and two small cotter pins.

From the band iron cut three pieces to the lengths shown in the drawing, and on each scribe lines where the metal is to be bent. Prick-punch the rivet-hole centers, but delay the drilling until later. Then flare the ends of the long piece by hammering from the center to each edge with light, even blows, and form scrolls by bending the ends around a ⅜" rod. File off the corners of the two shorter pieces and, with a vise or bending jig, shape all three brackets to fit the bottle.

Now drill the rivet holes, countersinking those in the surfaces adjoining the jar (see detailed drawing), and assemble the three pieces. Remove the hooks from the key chains, fasten the chains together into a single length, and attach the ends to the scrolls with the cotter pins. Finish with a coat of white enamel.—GLENN A. WAGNER.





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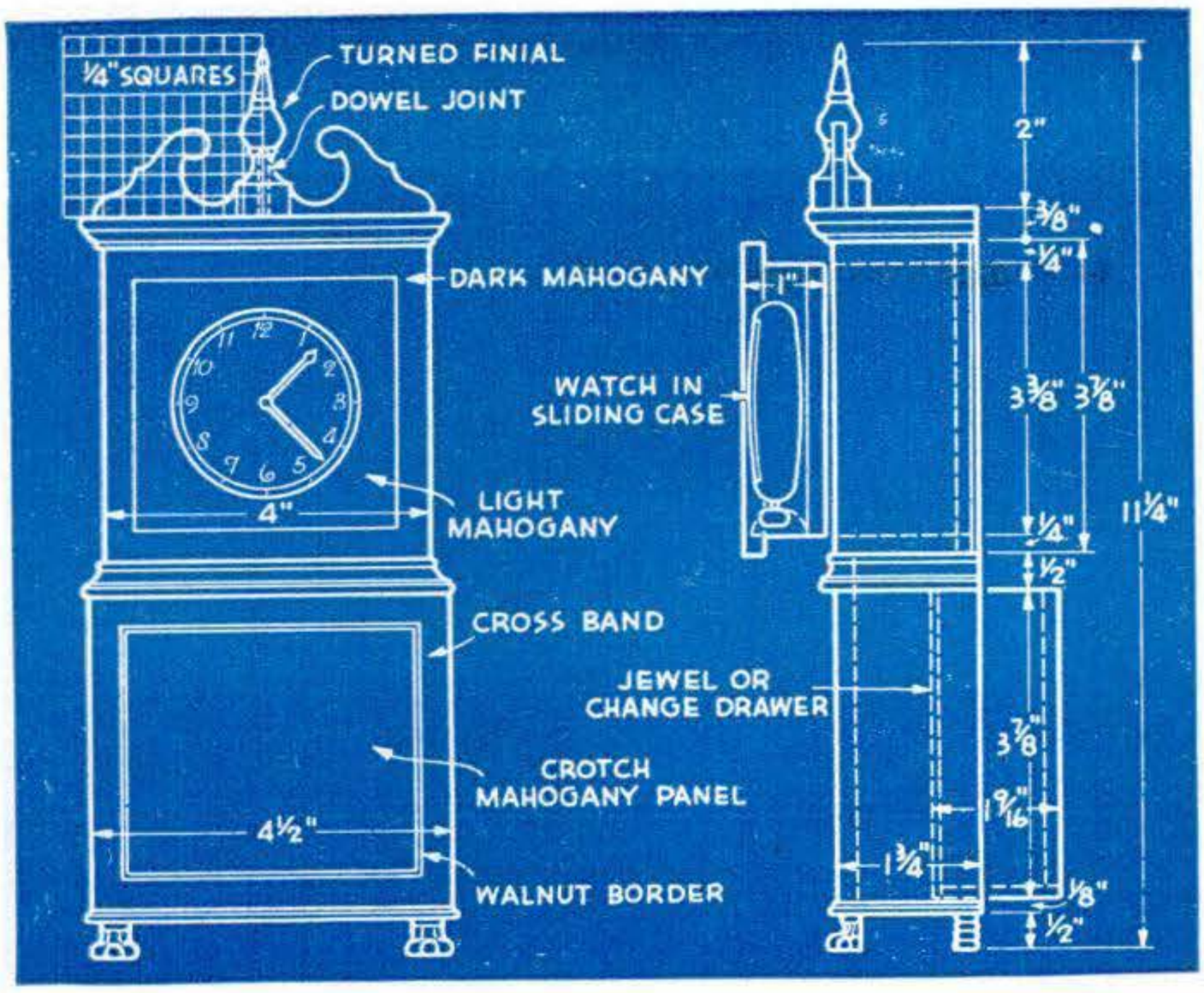
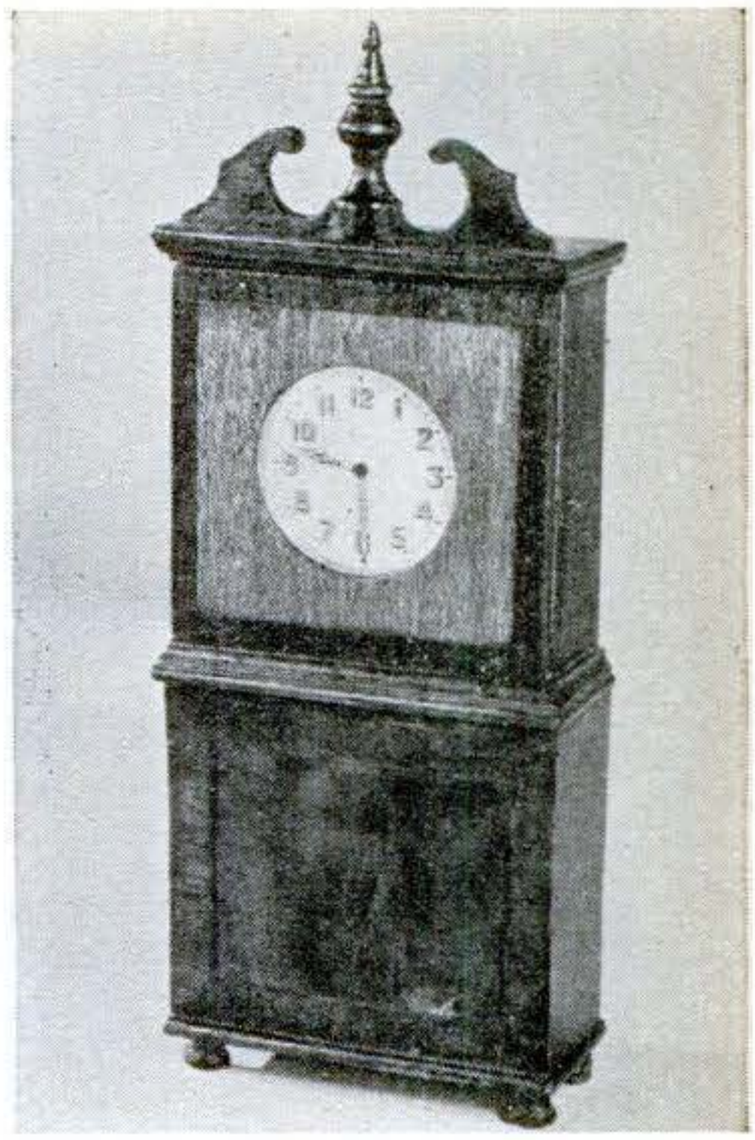




Miniature Mantel Clock Has Secret Jewel Drawer

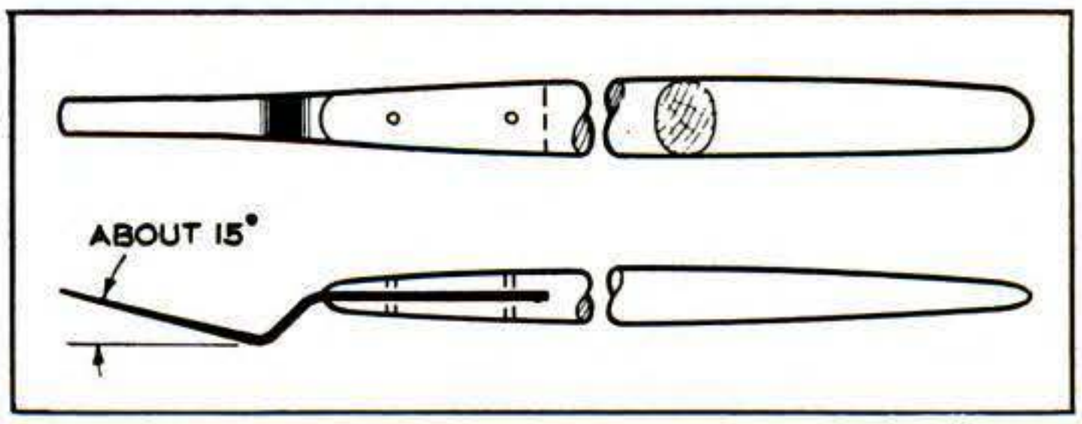
COPIED from an 18th Century model, this little mantel clock has its own secret—a hidden drawer in the lower section for valuables. A case sliding into the front encloses a small eight-day clock or watch.

The framework consists of sides ¼" by 1 9/16" by 8¼", between which two cross members are butted, one ¼" by 1½" by 3½" at the top and a second ¾" by 1½" by 3½" with its lower edge 3⅞" from the bottom. A 3/16" thick base for a mahogany veneer is placed across the lower part of the front between two ¼" by 1¾" by 3⅞" pieces glued outside the frame.

Units of the veneer assembly for the lower case are held together temporarily on a sheet of gummed paper. After the assembly has been glued to the case this paper is sanded away. If a veneer press is not available, hand screws or C-clamps can be used with pressure blocks under the jaws. The face of the upper panel consists of light mahogany ¼" thick bordered with dark mahogany of the same thickness. The back of the watch receptacle is screwed on. In the absence of a shaper the molding may be cut by hand with carving tools and a hand beader.—WILLIAM FREEMAN.

Caged Animals Are Party Favors

CERTAIN to delight childish fancy, this circus place favor consists of two paper saucers, about a dozen round toothpicks, a tiny animal bought in the dime store, and a whole-grain breakfast cereal on the floor as sawdust. If the animals are candy or cookies all the children undoubtedly will want to turn them loose!—BENJ. NIELSEN.



Palette Knife from Saw Blade

DISSATISFIED with the ordinary palette knife, I designed and made my own by inserting a 4" section of a soft-back hacksaw blade in a hardwood handle ⅜" by ⅝" by 8". The blade, bent without heating, was ground on the flat side of an emery wheel to taper from full thickness at the heel to quite thin at the point, and the edges were ground so that the width decreases from 5/16" at the handle to ¼" at the tip. Small brads and glue hold the shank. The blade proper is 1½" long.—J. H. CLICK.

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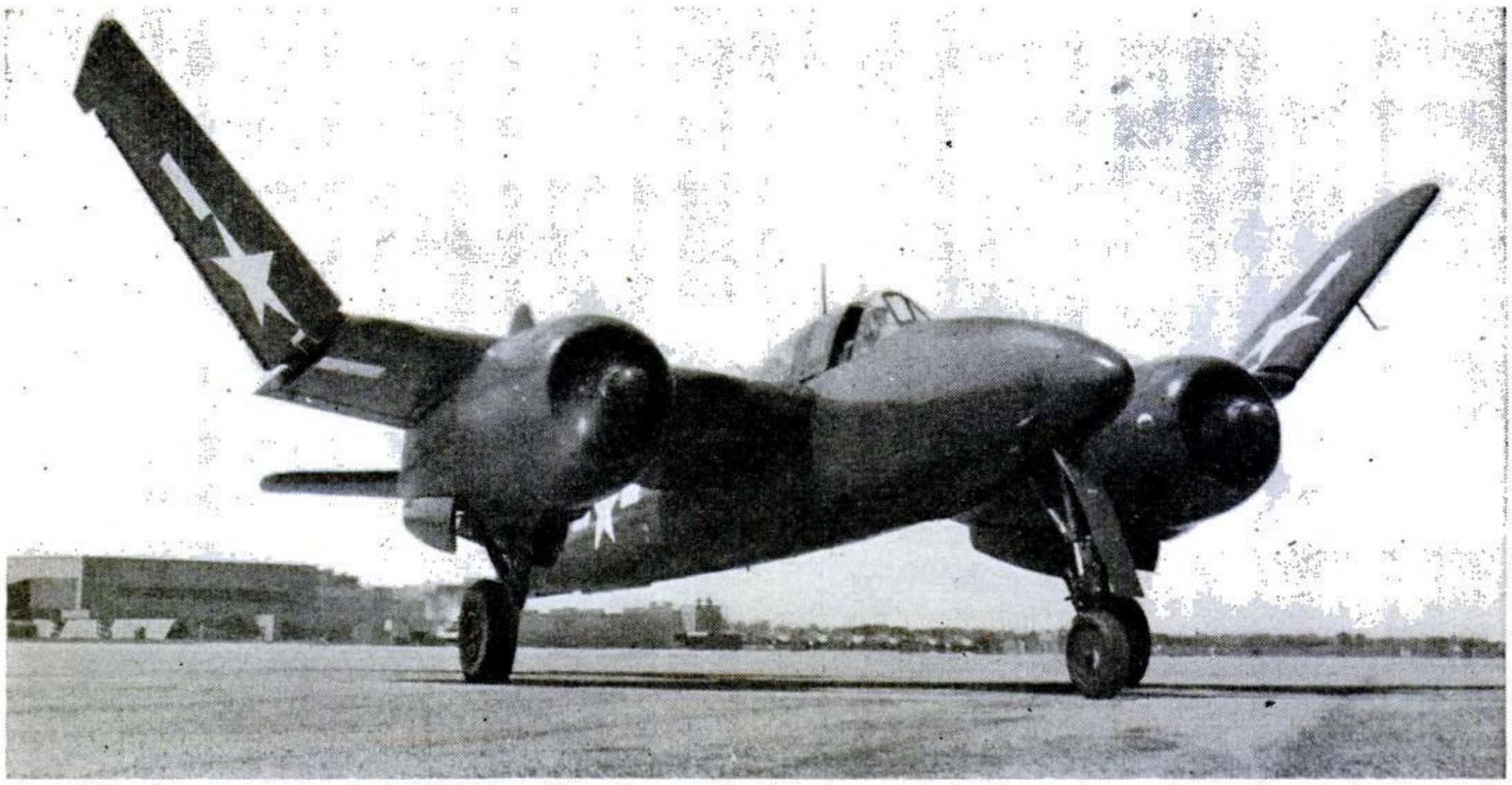
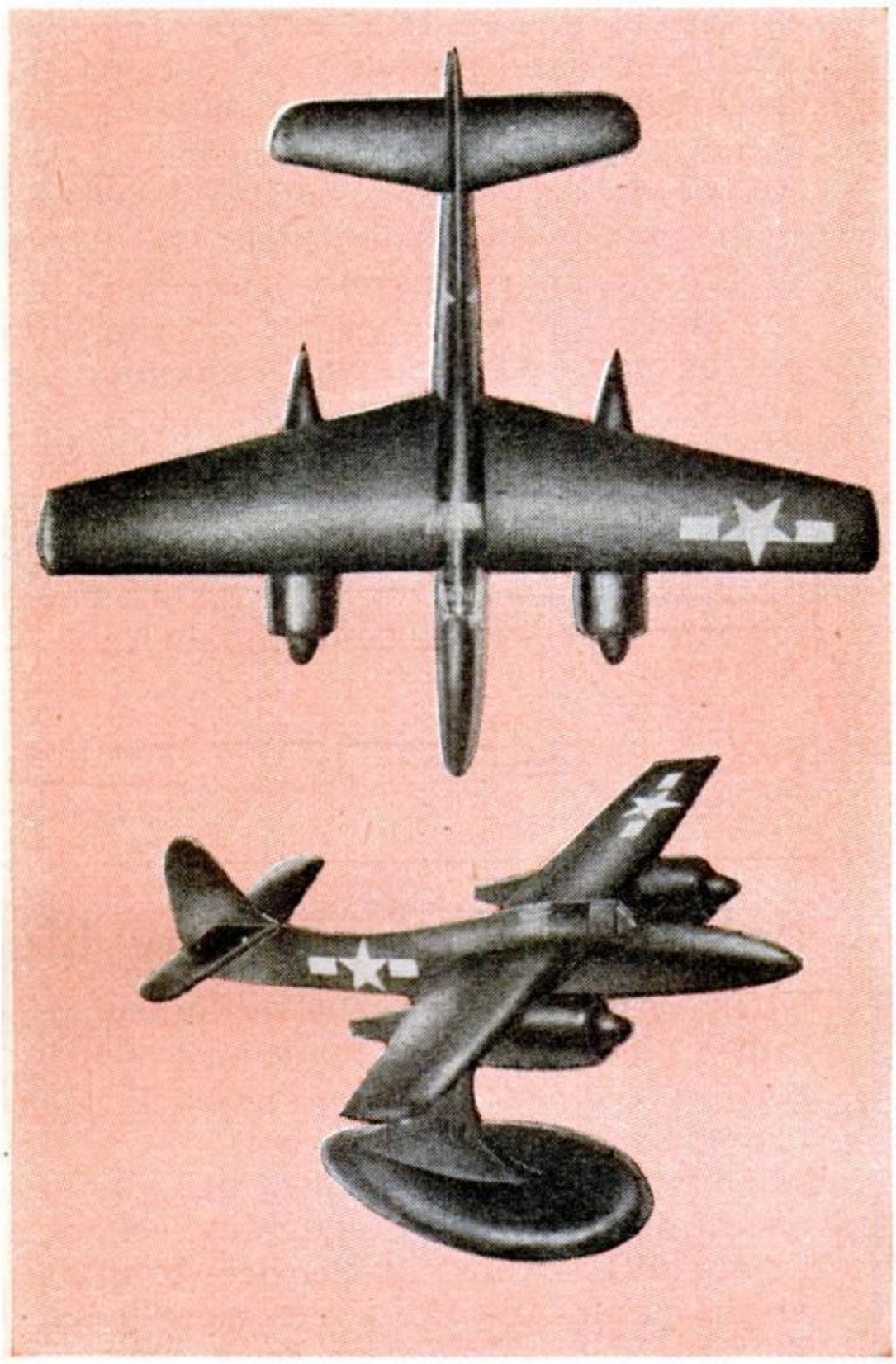


With its folding wings part way up, a Grumman Tigercat resembles a mammoth bird flapping its wings and about to take off. In firepower, this plane far exceeds its predecessors, the Wildcat and the Hellcat.

Scaling Down the Tigercat



Mounted on a streamlined pedestal, a solid model of the Navy's formidable new fighter plane makes a fine addition to any collection of warplanes.

By Paul Plecan

ONE of a line of Grumman Navy fighter planes, the Tigercat easily surpasses the performance of its famous predecessors, the Wildcat and Hellcat. Powered by two 2,100-hp. Pratt & Whitney engines, it climbs a mile a minute, has a reported top speed of around 425 m.p.h., and can carry a bomb load of 4,000 lb. Being designed for use on carriers, the plane has folding wings. Its wheels are retractable.

Since there's a two-place version (F7F-2N) for night fighting, you can include the rear cockpit or not, just as you desire, when building the solid model illustrated here. The first step is to enlarge the plans on the facing page to full scale size. If you can have them photostated, this will save you the trouble of tracing them on squares.

After the fuselage has been carved to shape with the aid of the templates shown, slot it and install the one-piece wing. Mount the tail surfaces next, being careful to align them with the wing. While cementing the cowlings in place under the wings, check from above to see that they are parallel with the fuselage.

When the model has been completed, coat it with wood filler to hide the pores of the wood and make it possible to obtain a smooth finish. Then apply several coats of dope and attach the insignia at the designated points. Celluloid propeller disks complete the model.

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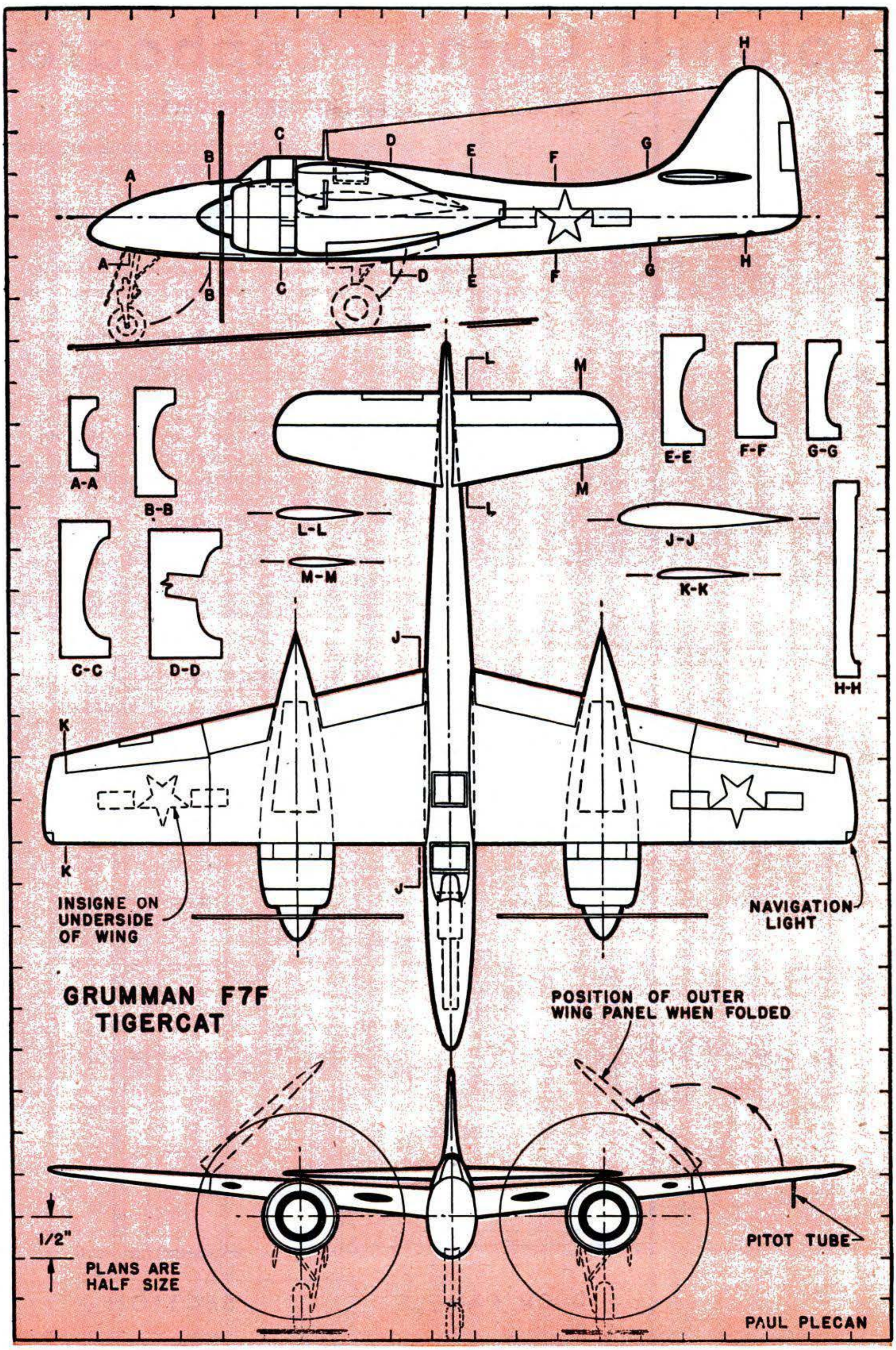

GRUMMAN F7F TIGERCAT

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Colonial Corner Cupboard

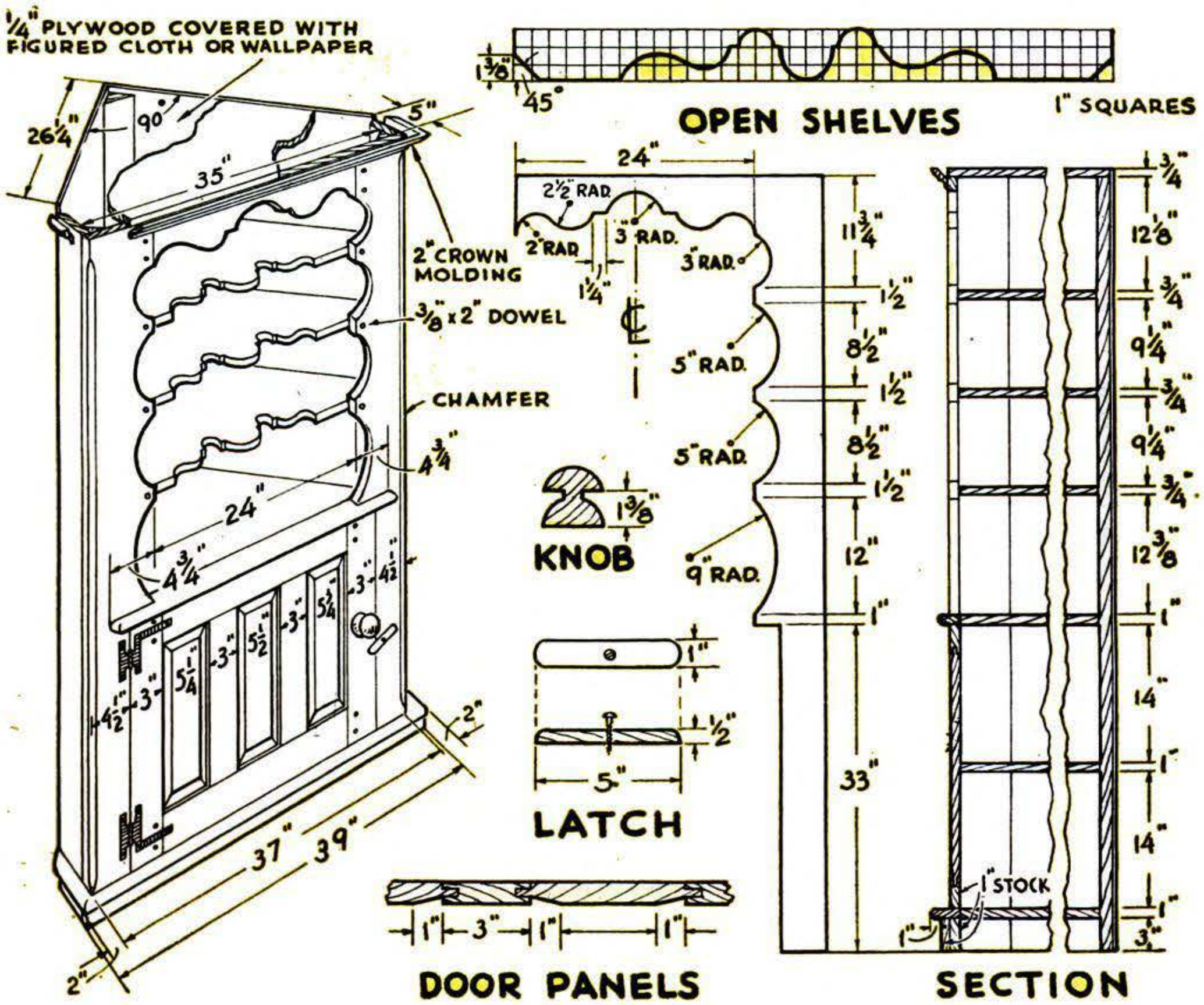
By NORBERT ENGELS

DINING rooms done in the Colonial manner are hardly complete without a corner cupboard. This one, designed for use with popular early American furniture, is particularly appropriate. It should be made of some wood like pine, poplar, or butternut that will take a deep honey-color finish.

Except for the ¾" stock of the shelves and the plywood backs, all wood is 1". The shelf edges may be jigsawed to the curves shown or left straight. Antique the shelves white before installing them. Wallpaper or figured cloth will look well on the back. The top molding may be stock crown or other design, either backed with a furring strip or not, and it can be flush with the top or can extend above it.

All important joints, such as those in the door frame, are mortised and then locked with dowel pins. A dowel split in half and rounded on the ends serves as a latch. The knob is turned on the lathe.

If you have trouble finding H-L hinges, they can be imitated satisfactorily. Use a plain flat-black butt hinge, and then add a flat-black corner iron on the door side and a straight iron on the other.



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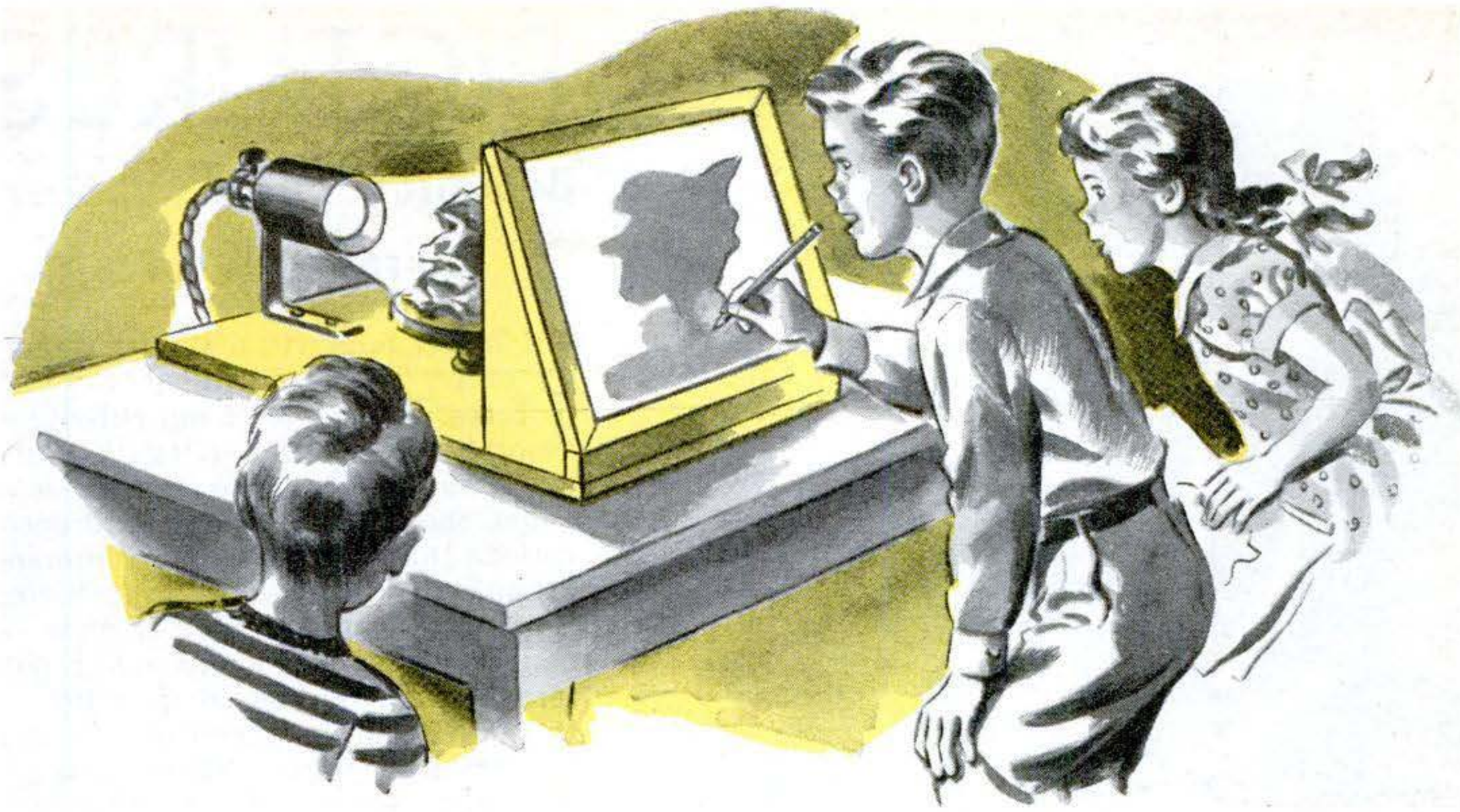
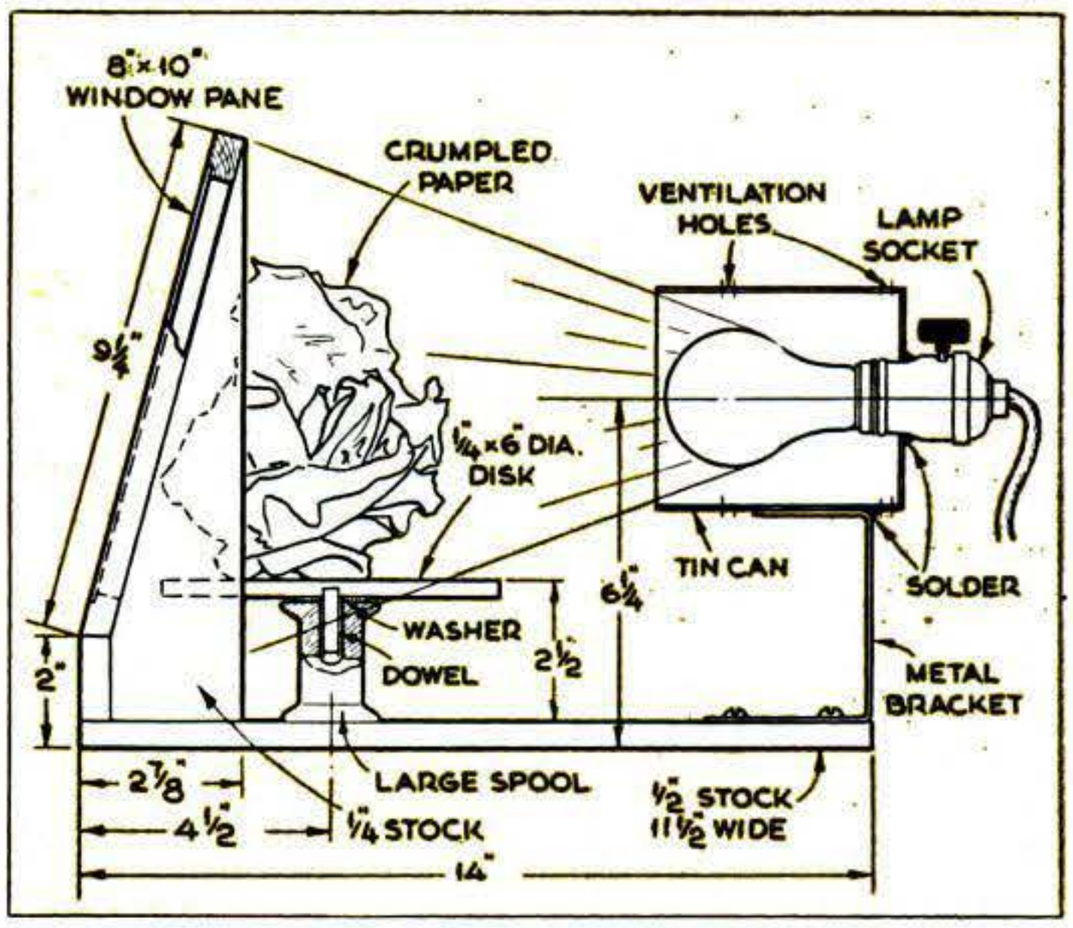


Shadow Projector Affords New Kind of Imaginative Drawing

ENDLESS designs can be created by use of this projection-tracing device. An object, a lump of clay, or some paper squeezed into a loose ball is placed on the platform, the shadow being projected on a sheet of paper laid over the glass. The device will develop imagination and drawing skill in children.

The young artist should study the profile hard and then, when he can discover some object in it, draw the outline and fill in minor detail. If after due cogitation no man, animal, insect, house, or other familiar object can be discerned, the platform should be turned on its pivot to change the profile.

Build the projector as shown at right, being sure to ventilate the spotlight can. A nonfrosted bulb, if available, produces the sharpest shadows.—O. FLUHARTY.

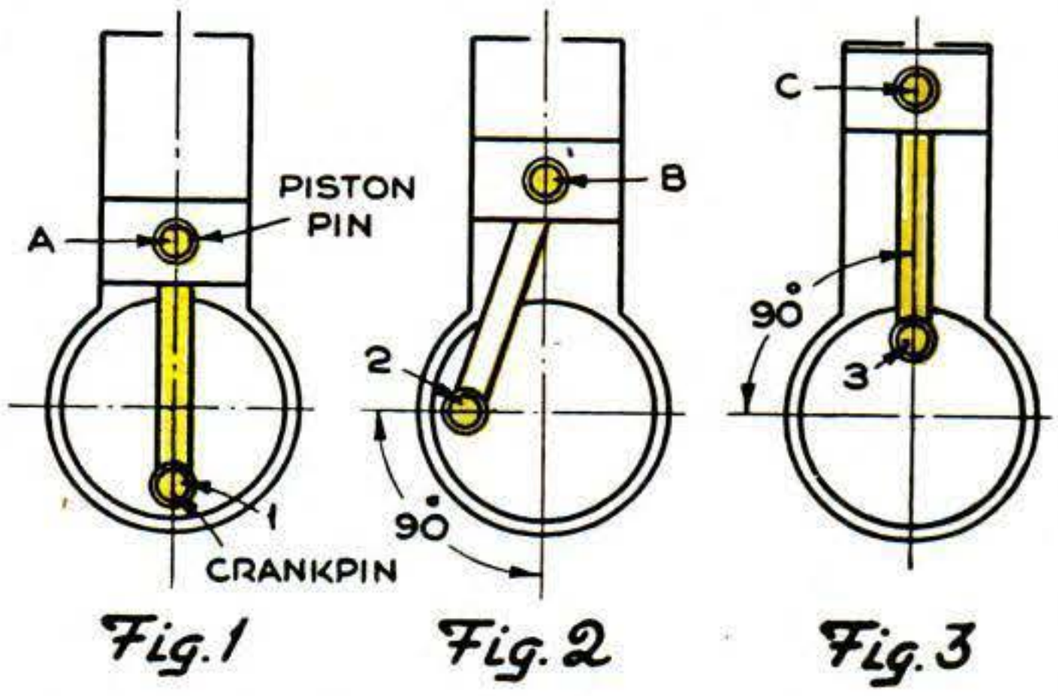


Sharpen Up Your Wits on This Crankshaft Puzzler!

This mechanical problem may fool even some gas-engine experts. When the crankpin in the drawing travels 90 deg. from position 1 to position 2, the piston pin travels from *A* to *B*, as indicated in Figs. 1 and 2. Then, when the crankpin travels 90 deg. from position 2 to position 3, the piston pin travels from *B* to *C* (Fig. 3).

Question: Are distances *A-B* and *B-C* equal? If not, which is the greater?

This sounds simple enough, but don't be led to a rash conclusion. After you have satisfied yourself on the answer, turn to page 194 for the correct one.—J. C. M.



You may need a pencil and paper to figure out this tickler, but try it without them first.

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PICTURES

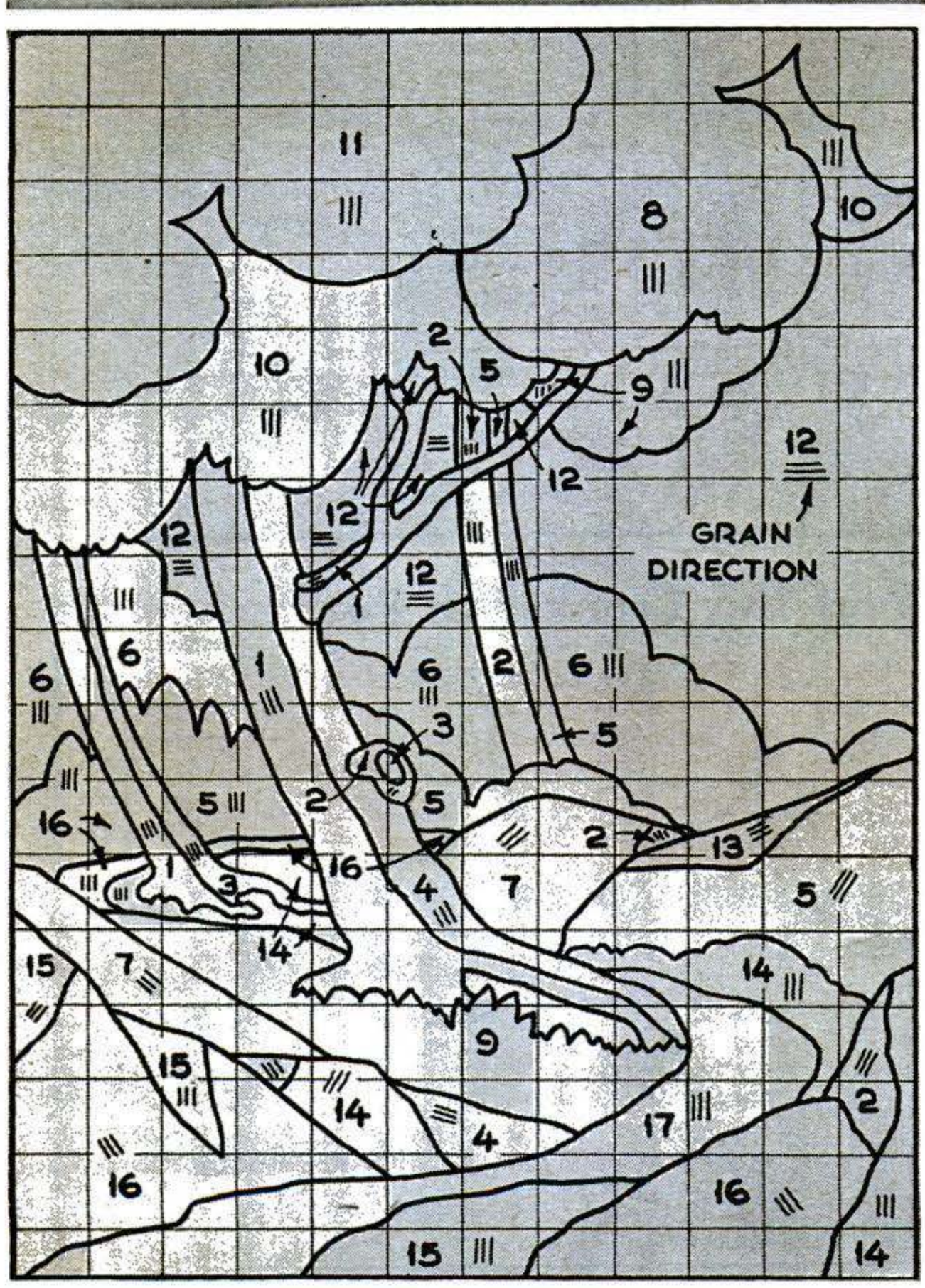
Beautiful Inlaid Veneers

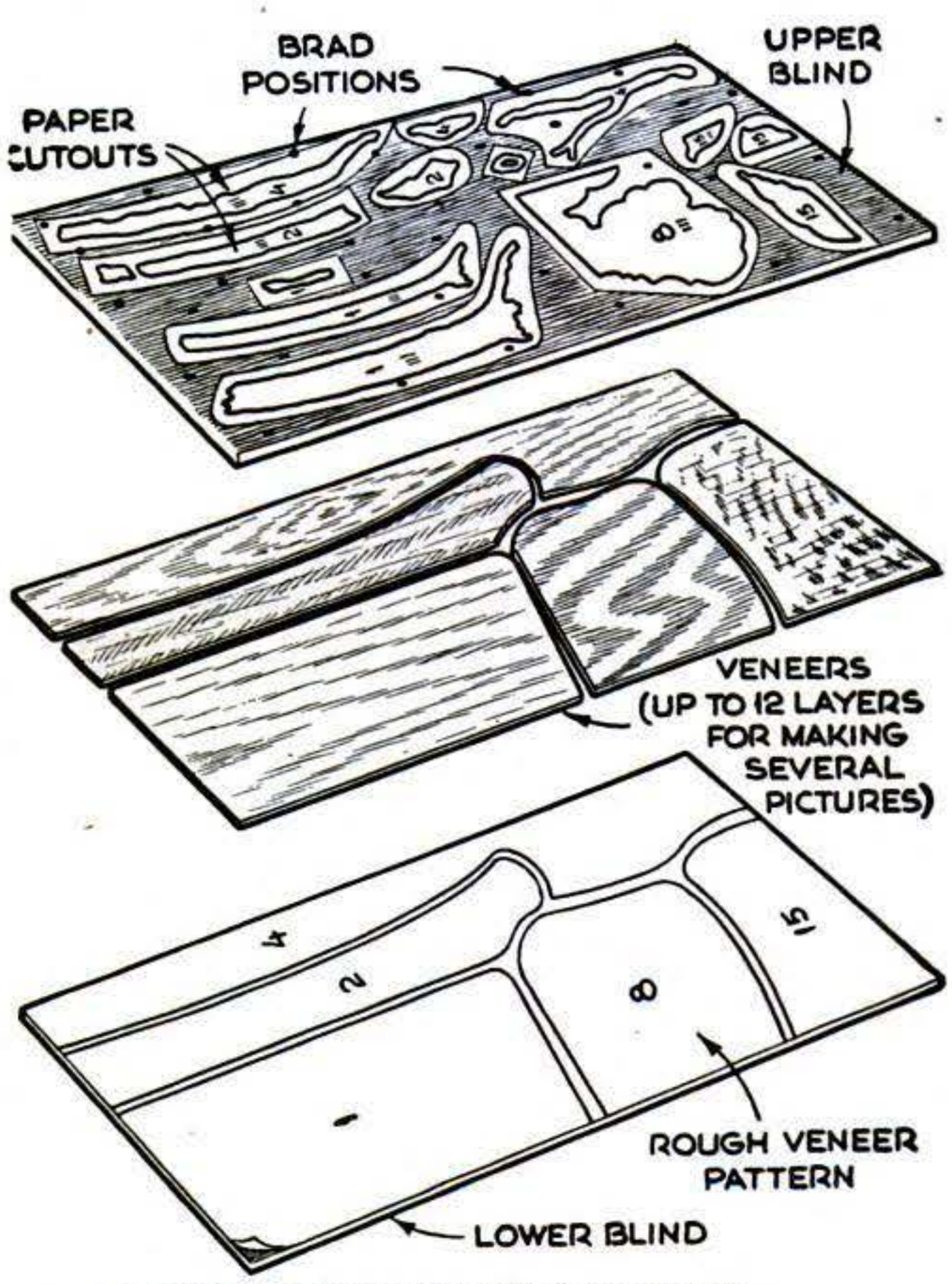
By EDWIN M. LOVE

JIGSAW fans will find an inspiring outlet for their talent in inlay pictures. Assembled from cutouts of assorted veneers fitted together and glued to a backing to form a solid panel, they make striking wall decorations that seldom fail to command attention. All materials, including a dozen or more veneers, a plywood panel, and several copies of the pattern, can be purchased in a kit, or the craftsman can collect his own veneers and compose his own design.

If only one copy of the design is at hand, several additional copies must be made. Sketch the layout accurately by means of squares or make a careful tracing of it for a master drawing. Fill in the spaces with key numbers denoting the kind of wood to be used and add small lines showing grain direction, as in the drawing at left below.

The master drawing can be pricked around the outline with a needle for transferring to other sheets with pounce or similar powdered charcoal. Or, since only eight copies will be





METHOD OF ASSEMBLING PADS

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FROM YOUR JIGSAW

Challenge Your Artistic Sense and Your Skill as a Craftsman

needed for a design like that illustrated, it may be more convenient to reproduce the pattern with carbon paper, making four at a time on onionskin paper. Painstaking tracing with a sharp, hard-lead pencil will produce clean copies. The numbers and grain lines are also traced.

As the veneers are fragile, they should be protected during sawing by "blinds" consisting of ⅛" poplar or three-ply sheets above and below. Make the blinds a convenient size, such as 5" by 9". Then cut out patterns for the various veneer pieces with scissors, leaving about ¼" margin around the outlines. Paste these patterns on the upper blinds, grouping like numbers together and nesting them loosely with the grain direction as called for.

Lay tracing paper on a pasted top blind and roughly outline each number group; then with carbon transfer these rough lines to appropriate veneers. Lightly paste this tracing to a bottom blind with the edges aligned. Saw out the roughly outlined veneers and attach them to the lower blind with dabs of paste, as in Fig. 1. Then lay the top blind on, put the pad on waste wood, and drive fine brads through the edges about 2" apart, as shown in Fig. 2. Pry the pad gently from the waste, snip the brads off to about ⅛", and then clinch the ends.

Obviously the veneers are chosen for desired swirls and straight grain necessary for the design being followed. For production work, up to a dozen thicknesses of standard 1/28" veneer can be made up into a single pad, and pieces can be sawed at one time for a dozen copies of the same picture.

No special jigsaw setup is necessary, for the sawing is routine. Have the table square with the blade and, if possible, use a blade guide below the table as well as above. Since each piece is surrounded with waste wood, there will be plenty of space in which to maneuver, and very fine blades are not required. Select a piece near the edge of a pad to saw first, avoid forcing the feed, and work in the waste while splitting the line. Start with the larger pieces, tie the blinds together with the veneers as they are cut, and lay them aside in a box. When small members must be sawed out, it will be time to begin assembling. The sawing operation is shown in Fig. 3 with a box conveniently clamped at the edge of the table.

Using one copy of the drawing for a base, as in Fig. 4, stick the large foliage pieces to the upper left corner with dabs of paste or rubber cement at the edges—not in the center, which would warp the veneer. Try

1 After duplicate patterns have been made and the parts numbered and marked with direction of grain, individual templates are cut and grouped according to type of wood. Veneers cut to fit the groupings roughly are put on the bottom blind with dabs of paste.

KEY TO VENEER LAYOUT

1. Primavera.
2. Satinwood.
3. Lacewood.
4. Padouk.
5. Maidou.
6. Rosewood (Brazil).
7. Birch.
8. Tamo.
9. Maple burl.
10. Walnut butts.
11. Bird's-eye maple.
12. Quartered maple.
13. Avodire.
14. Greenheart.
15. Sycamore.
16. Purpleheart.
17. Curly maple.

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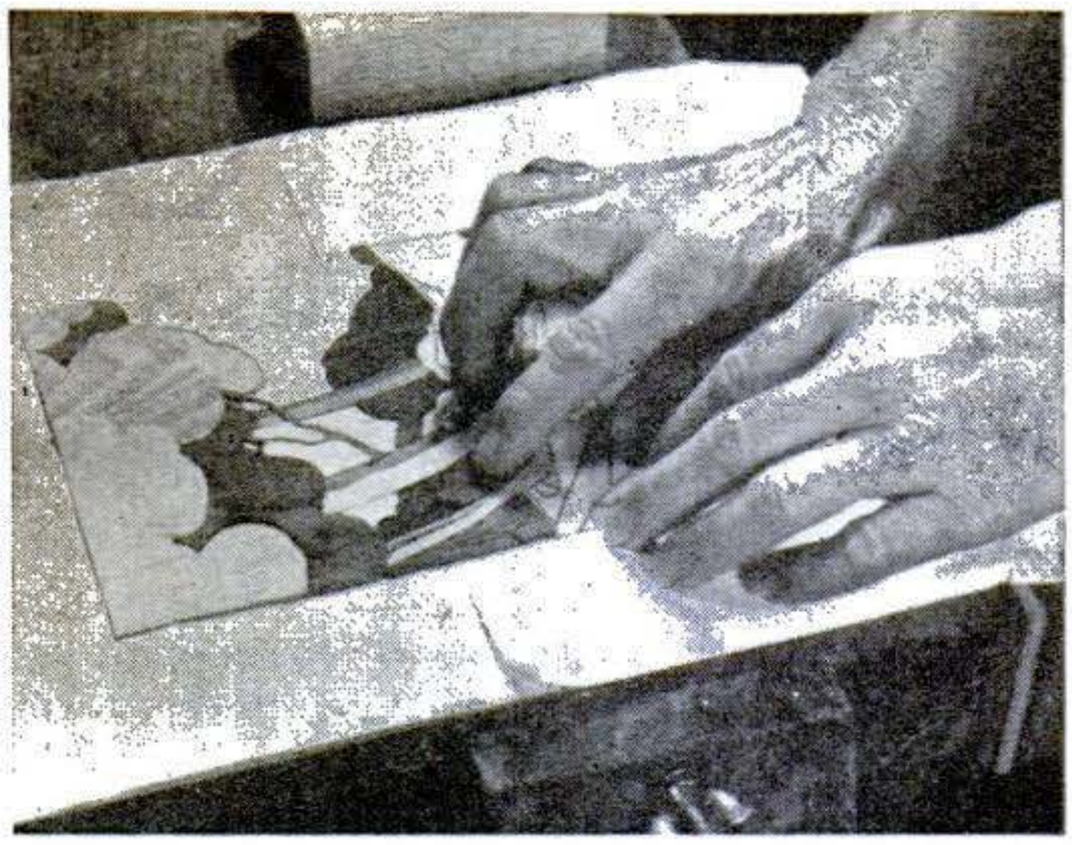
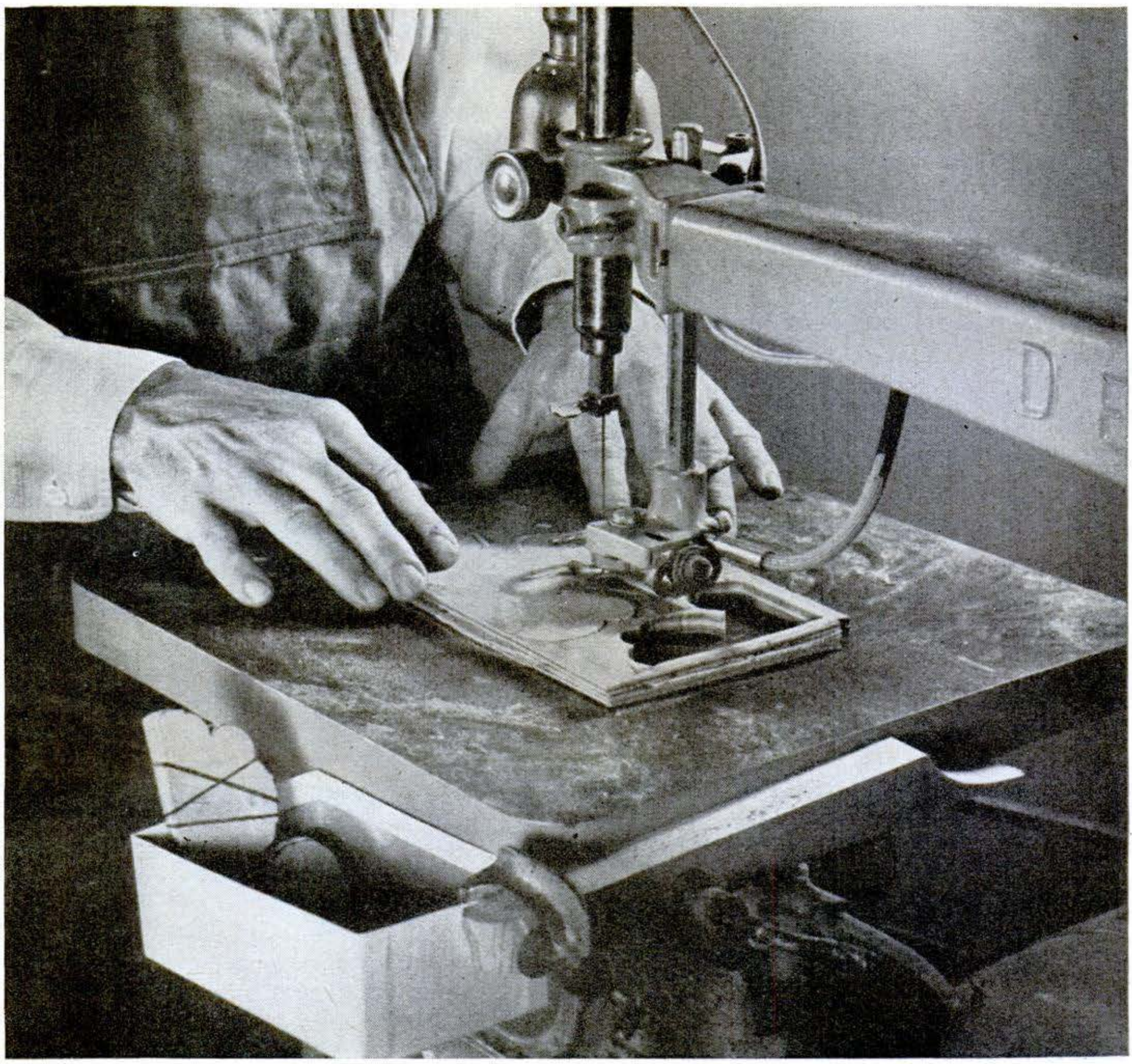


2 Adding a top blind with individual patterns pasted in place forms a pad for sawing that prevents splitting of the fragile veneers. The pad is held together with fine brads driven in 2″ apart at the edge and clinched on the underside.

4 Assemble the veneer pieces on a pattern. Put large ones on first, starting at one corner. Then stick the small ones in, sawing them from the blind as you need them. Use the adhesive in small dabs at the edges only in order to avoid warping.

3 Sawing the pieces is a routine jigsaw job. The blade cuts in waste wood and splits the line. Saw the large outer pieces first and tie the blinds together with the veneers between as each is sawed.



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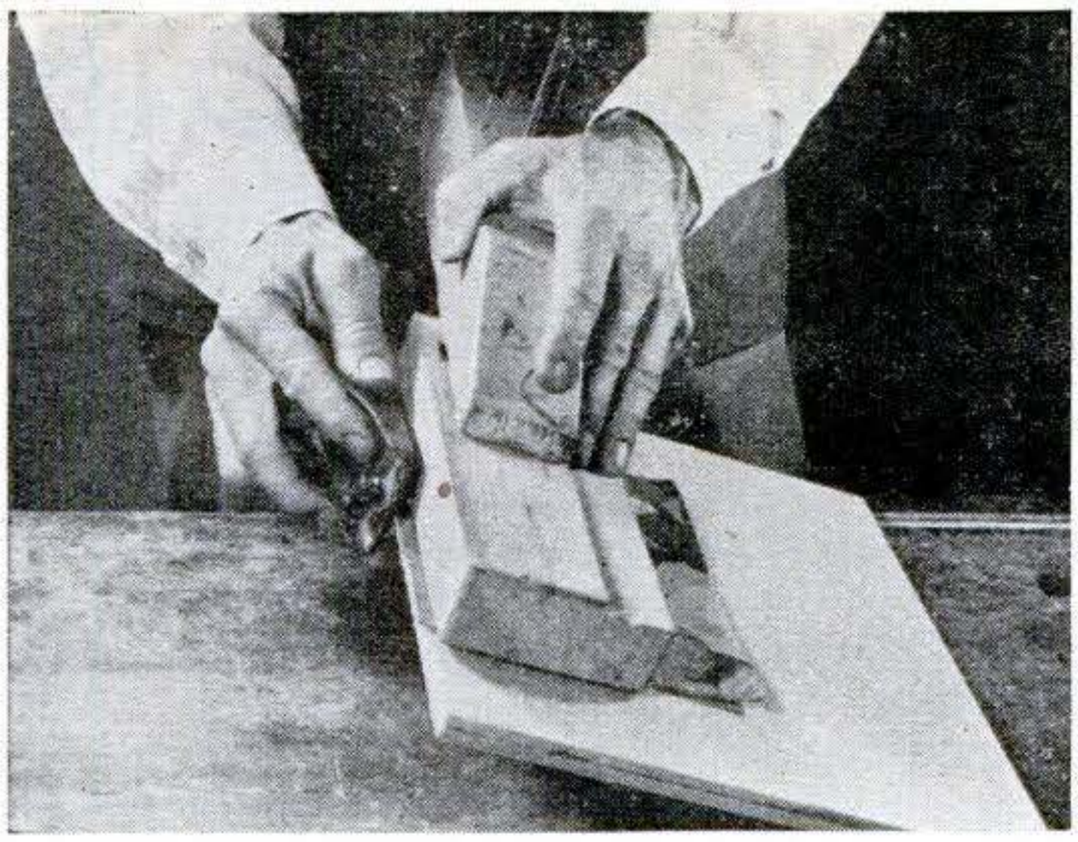
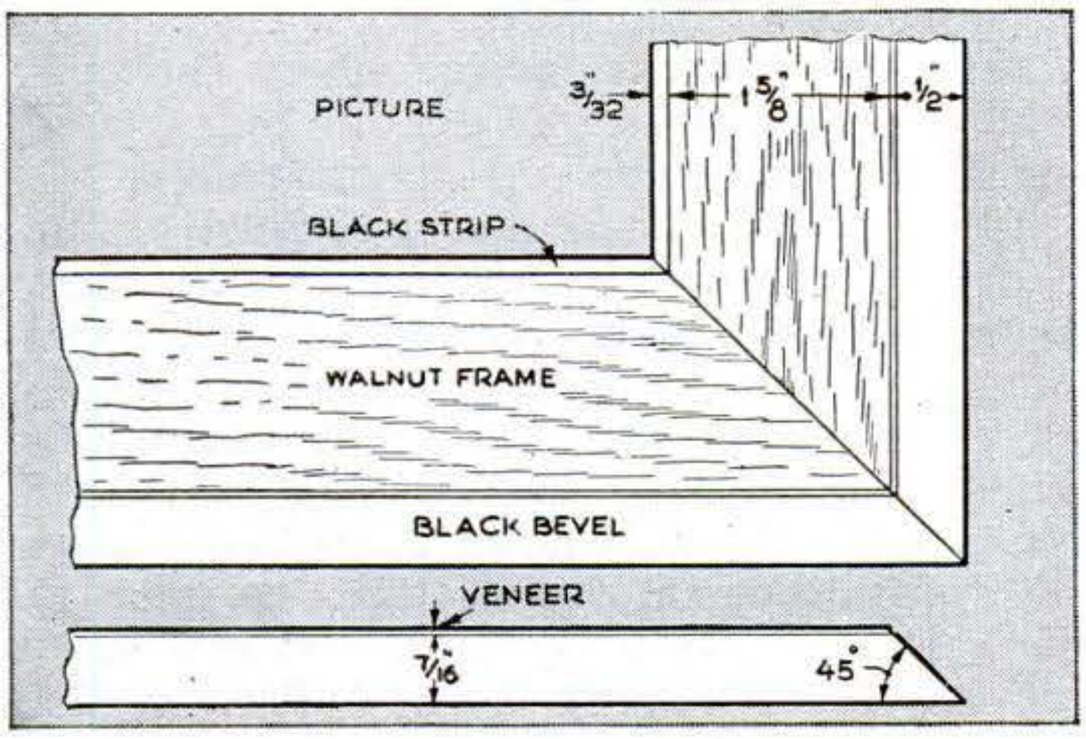
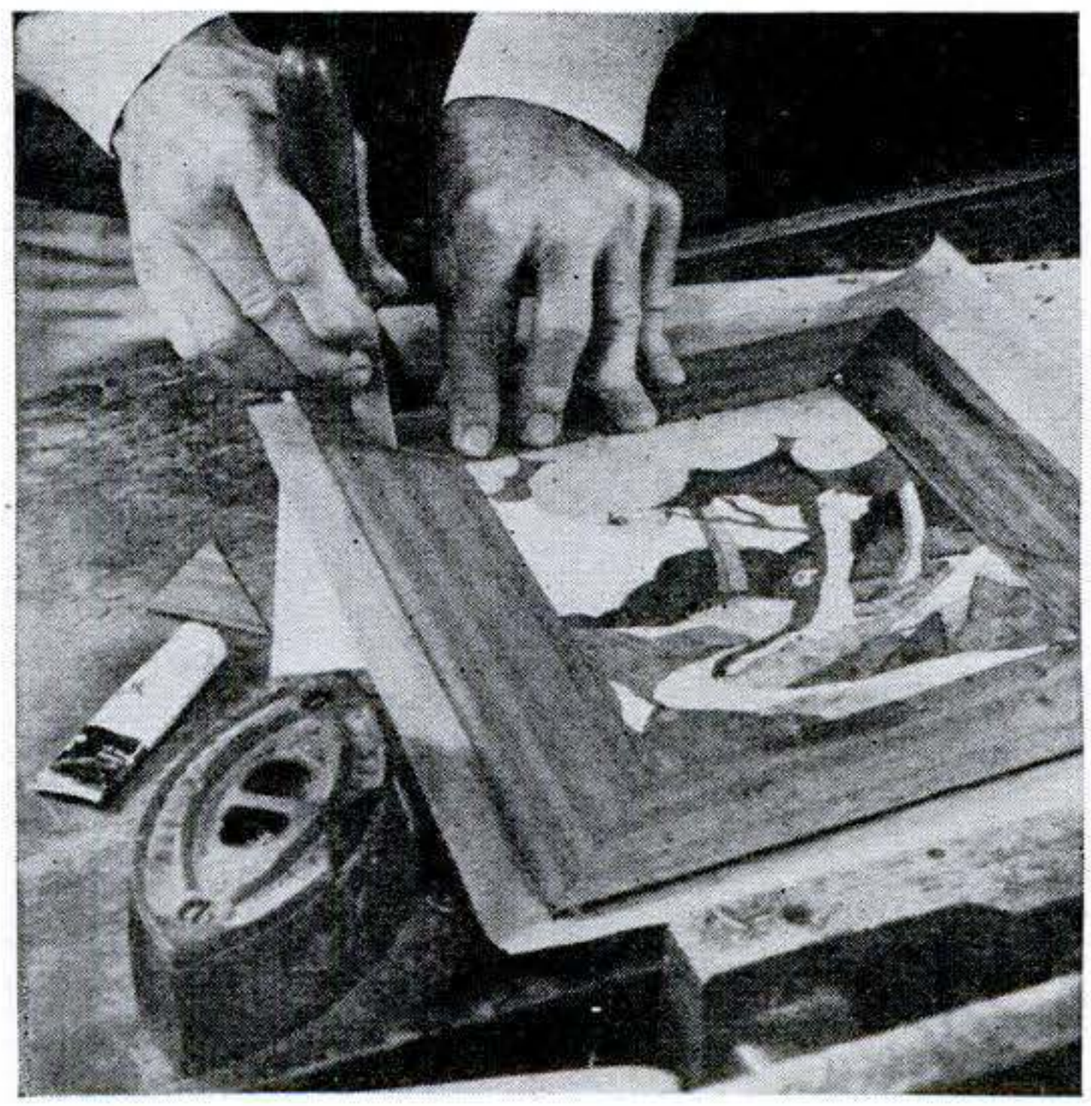


5 With the assembly completed, trim the paper at its edges, clamp between blocks, and then joint one side. Reclamp to straighten a second edge, and so on for the four. Heavy paper is next glued to the face, and the original paper removed.



6 Border and frame are attached to the heavy paper, and the piece is glued on firmly to a backing board. For accurate mitering, cut only one end of each piece to shape at the start, and use this end as a template for the mating end of the next piece. A sharp knife makes a good tool.



the next piece for fit, correcting slight inaccuracies with a sharp knife or with a gouge and block. If the piece seems hopeless, it is a small matter to cut out another; but with careful sawing such extra work should be unnecessary. Continue assembling, adding small pieces as they are sawed.

When this has been completed, trim the edges from the paper pattern and clamp the assembly between two boards with one edge projecting slightly for jointing with a block plane, as shown in Fig. 5. Straighten the other edges the same way. Then coat a piece of wrapping paper with water-soluble glue, rubber cement, or paste, and press it smoothly over the face of the veneer assembly. The paper should be large enough to leave room for gluing on a board and frame.

Lay the picture on the back panel with the wrapping paper up, cover with several thicknesses of newspaper, and top with a flat board. Load with weights and allow it to dry; then remove the original pattern paper, sponging with a damp cloth, if necessary, and pressing under paper until dry.

Joint one end each of four frame veneers and miter that end with a veneer saw or knife point, using a miter square as a guide. Miter also one end each of four narrow black strips. Glue one black strip to the paper at one edge of the picture with the mitered end at one corner and add the frame strip, pressing the edges together. Fit the mitered end of the next strip and frame against the first and glue in position. Use the mitered end of the third frame and border as a template for cutting the end of the second, and repeat with the fourth. Now take the length of the two fourth pieces, miter the other end, and use them as patterns for cutting the miter on the end of the first pieces (Fig. 6). Complete gluing.

Cut the backing panel ½" oversize and coat both it and the bare side of the picture with a medium mixture of casein glue. Put them together in a press with a paper pad and a flat board on top, or use handscrews. When the glue is hard, clean off the wrapping paper, again with sponging if necessary, and level the surface with a square-edge scraper drawn in diagonal strokes. Clean out open joints with a dull knife if bits of adhesive collect in them, and then fill the joints with a mixture of glue and sawdust from the jigsaw or sanding-disk powder. When dry, smooth again.

Finally trim the backing board to size, bevel the edges, and stain or paint them black. Fill the veneer with several coats of white shellac and wax it, or finish with varnish and wax. To hang the picture, bore a hole near the top part way through from the back to receive the head of a nail driven into the wall.

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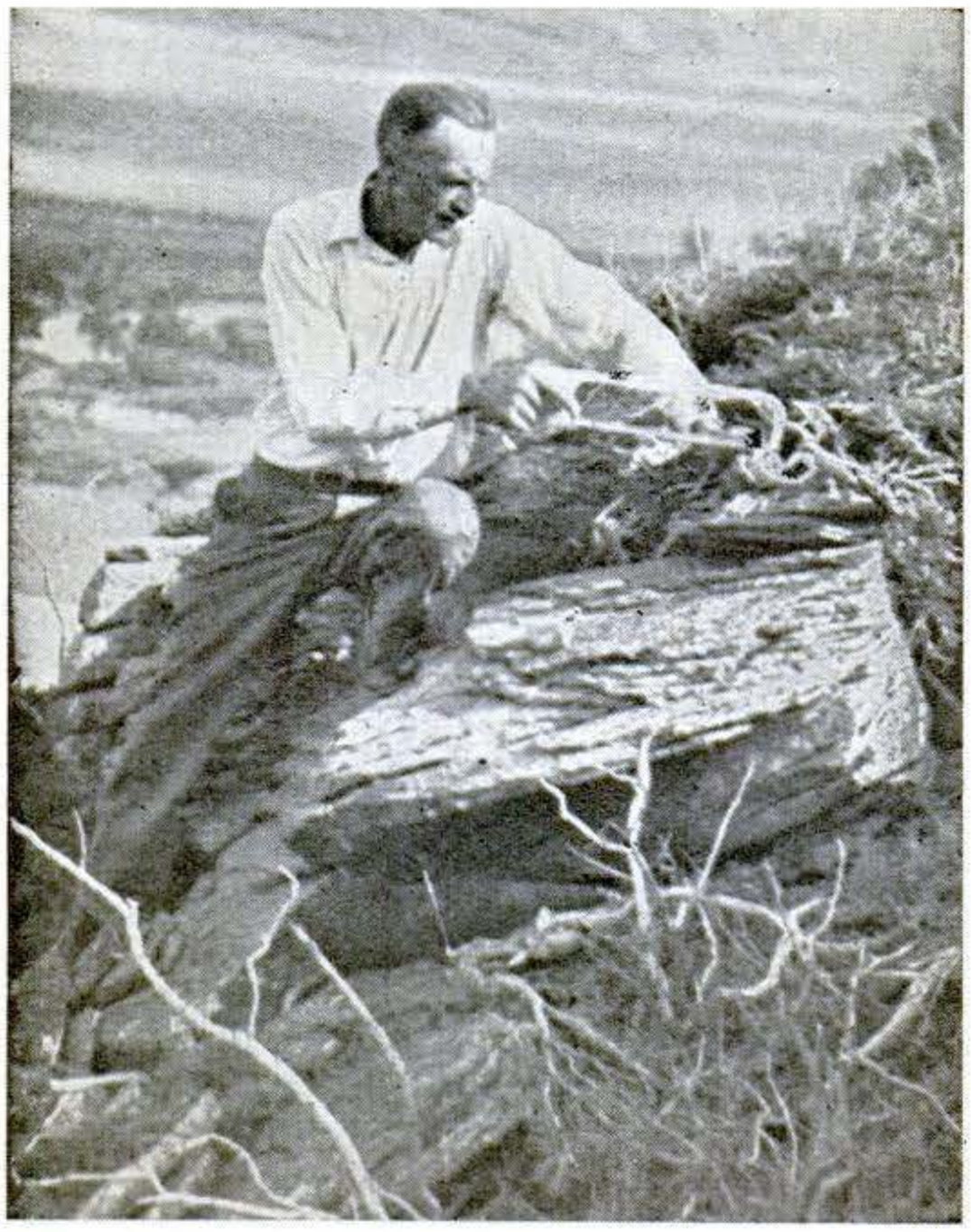
NEW ART FROM OLD ROOTS

Artist Carves Figurines from Grotesque Growth of Juniper Bush



When he needs material, sculptor Garstang-Hodgson saws it out from a root growing near the surface.

LIKE the ugly duckling that changed to a swan, grotesquely twisted roots of the common juniper bush become figurines of surpassing beauty and form in the hands of an Alberta rancher turned sculptor. The artist who works these miracles is W. Garstang-Hodgson, whose unproductive range in the badlands near the little Canadian frontier town of Dorothy diverted him to wood carving. It was an accident with a horse that gave him his unique medium.

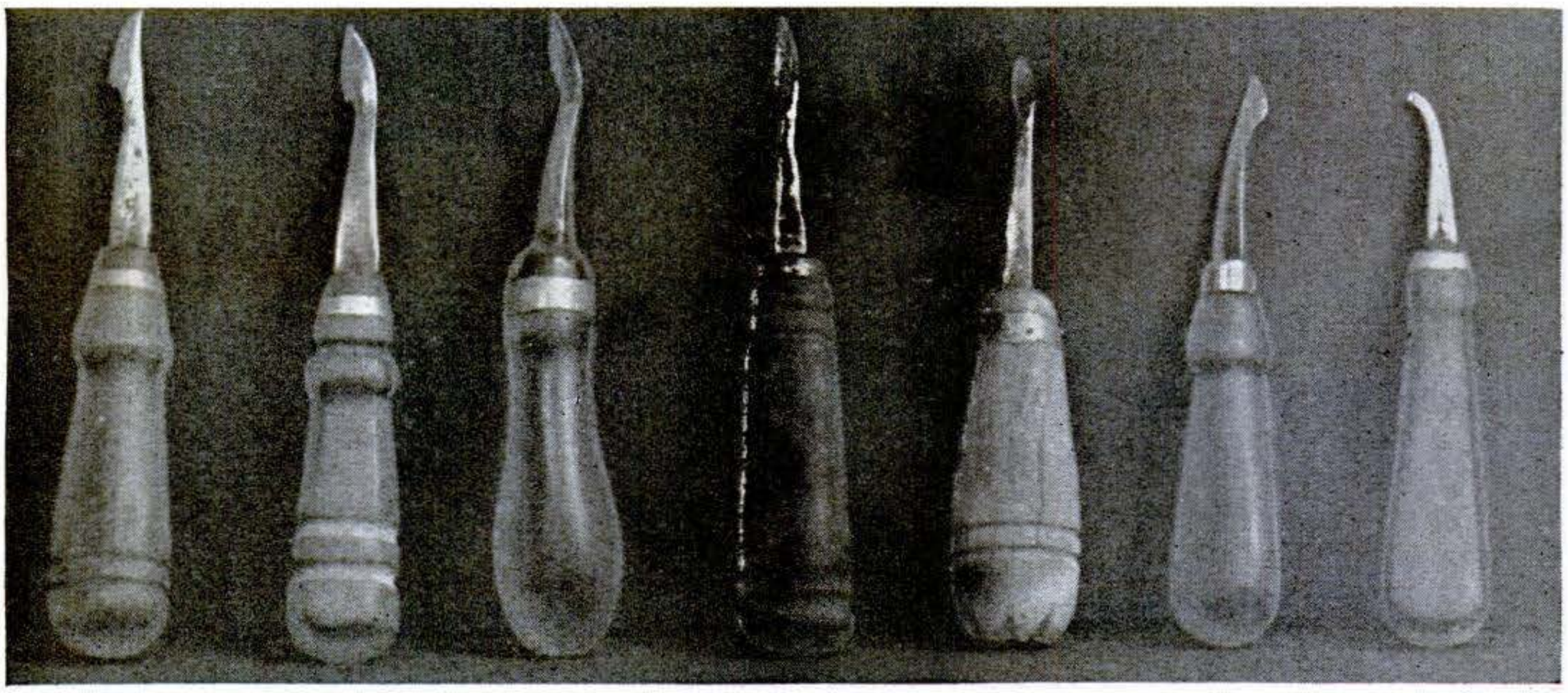
Some 15 years ago when ranching, in common with many other businesses, had difficulty in surviving a depression, Garstang-Hodgson found time to indulge a long-cherished ambition to carve in wood. He could not have chosen a worse place to obtain materials. But he began with the bark of the cottonwood. He achieved some fine pieces, but was not satisfied.

Then one day while rounding up cattle along a steep coulee, he fell with his horse. A juniper root had pulled off a shoe. Garstang-Hodgson was fascinated by the curious shape of the root. He hunted around until he found other odd-shaped pieces.

In their bitter struggle for survival in the badlands, these roots groped for moisture near the surface and assumed gnarled and fantastic forms. An entirely different method of wood carving had to be devised to utilize these twisted materials. Where other sculptors could plan their figures in advance, Garstang-Hodgson found that he had to defer to his material and conform his carving to the twists, curves, and hollows of the wood. New tools also had to be designed, so he collected special steel in junk yards—sickles, disk harrows, valve stems, and magnets from old Fords—and ground and tempered his own.

Some of the results of his new art are

These tools were specially designed for following the grotesque curves and hollows of the gnarled juniper roots. They were ground by the artist from sickles, harrows, and valve stems he picked up in junk yards.



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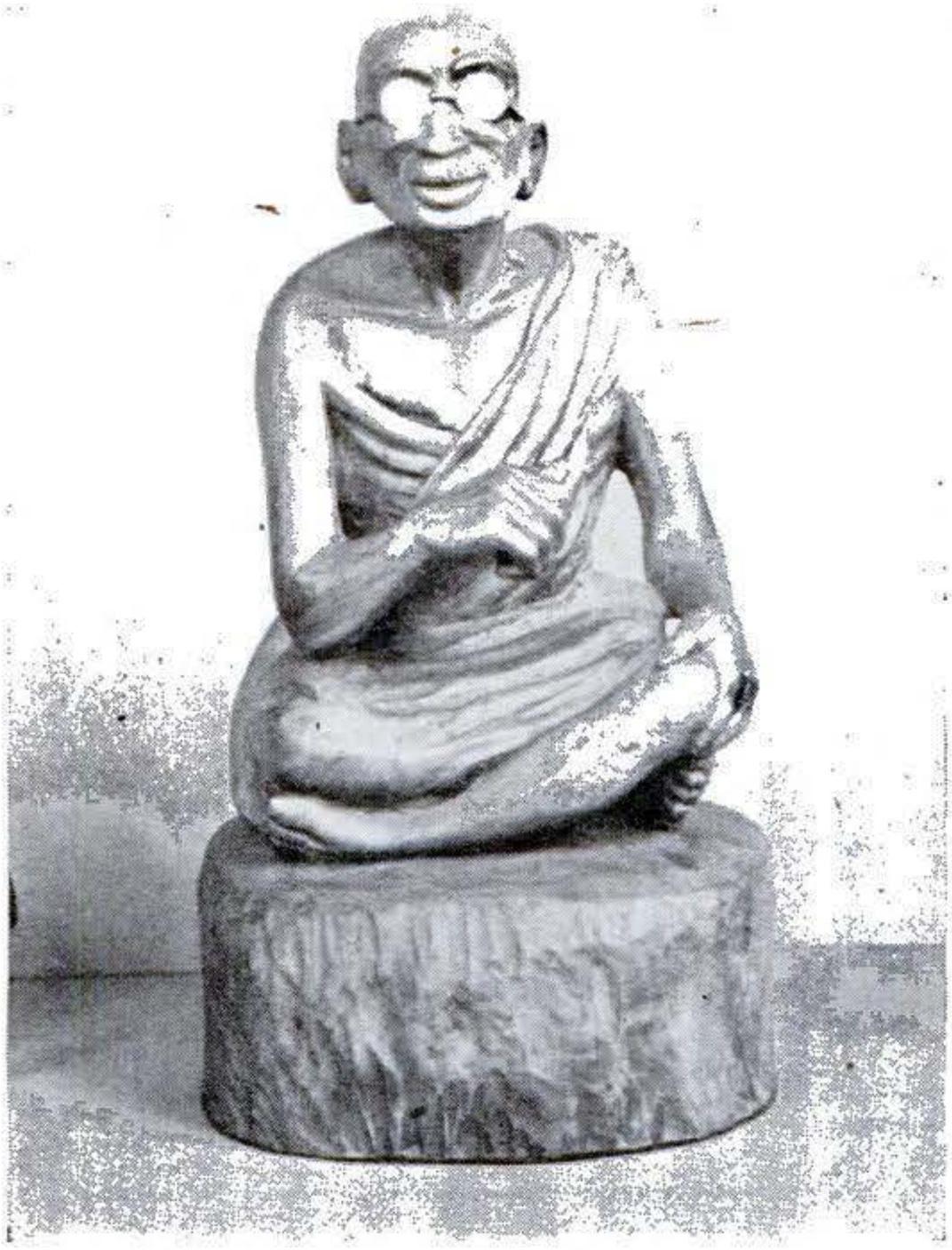

Products of gnarled juniper roots, a likeness of Gandhi is shown above and a remarkably detailed Indian at the right. Most of the artist-rancher's figurines are 12" high; others are 6" to 18".

shown in the accompanying photos. He has exhibited in New York and other cities and attracted admirers to his ranch studio. Recently one of these, an art dealer from Paris, liked his work so well that he selected 100 pieces to take back and display on the Rue de la Paix.—FRANCIS DICKIE.

Adapted to natural twists of the wood, these figurines are marked by a magnificent sweep of line, grace, and action, expressing pain, sorrow, contemplation, or the swirl and flare of garments in exotic dance.

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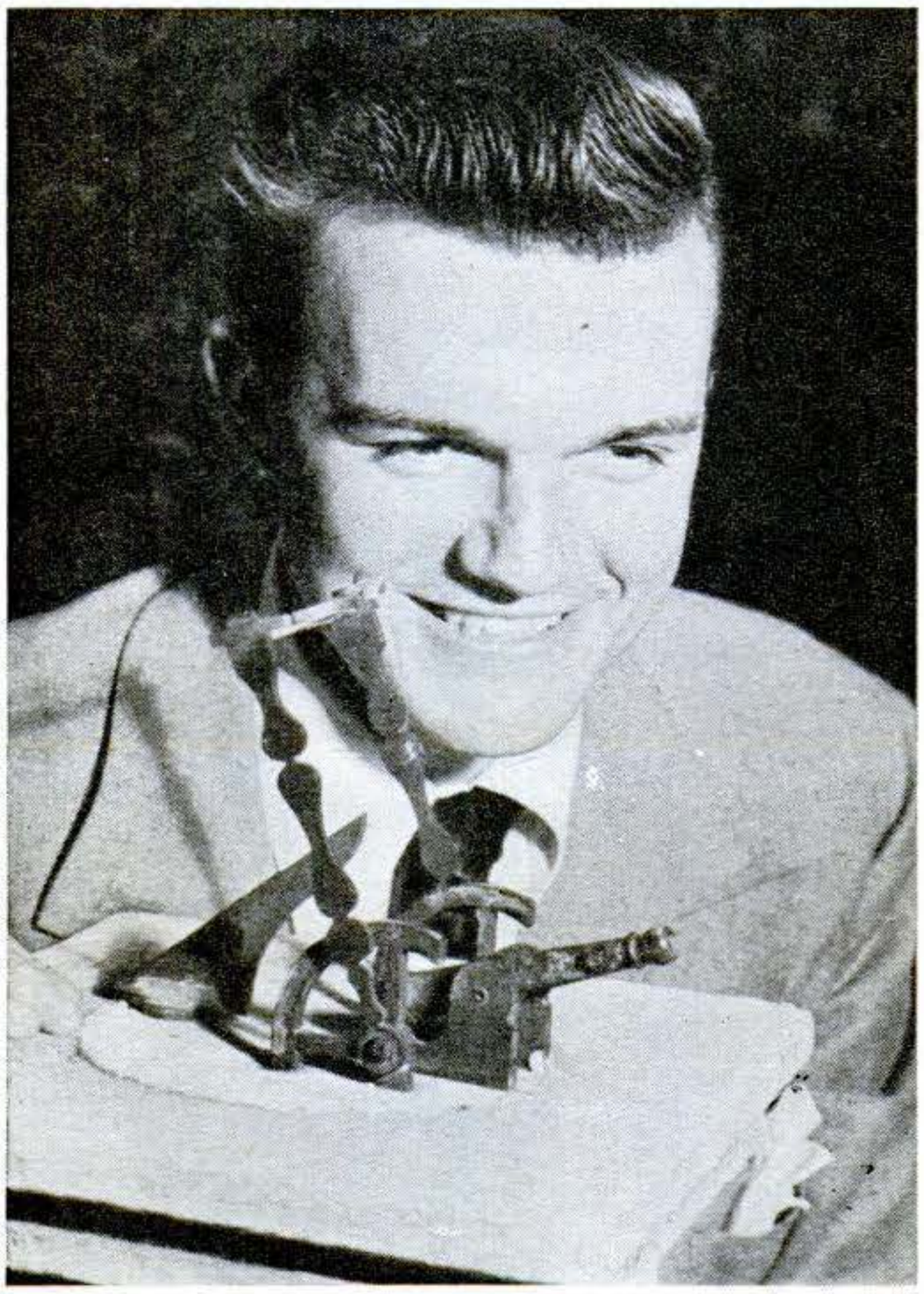
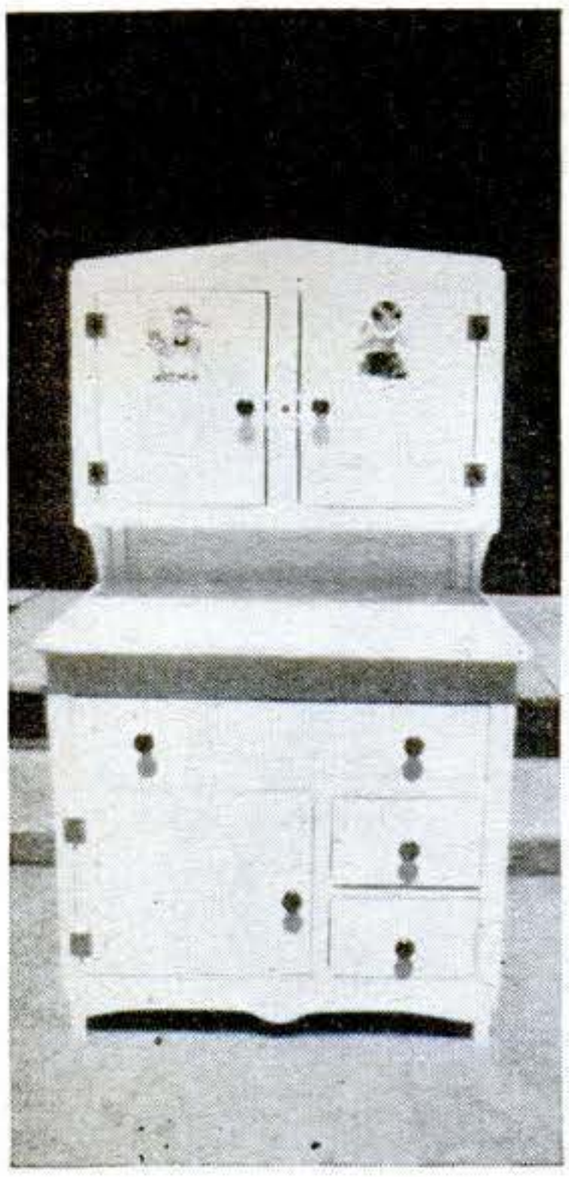
CRAFTSMEN AT WORK



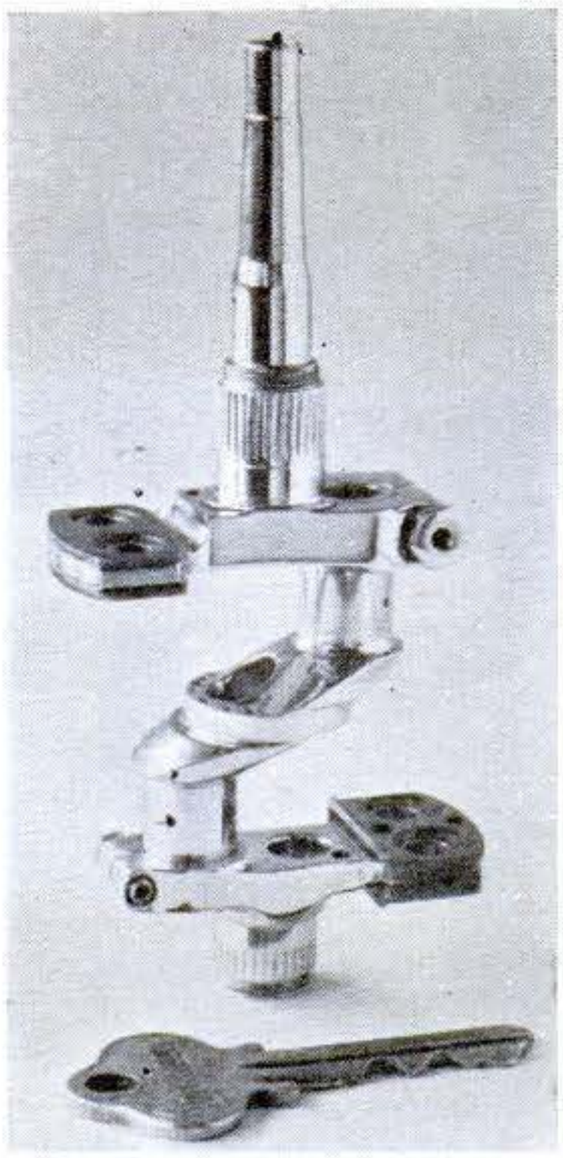
SUNRISE GUN. This little cannon was used in place of an alarm clock to awaken movie actor James Cardwell while he was on location recently, according to his press agent. Focused by a magnifying glass, sunlight ignited a fuse, and the cannon went off. Of course it didn't work unless the sun was shining—but neither did the film cast.

SHIPYARD WORKERS will recognize this as a working model of a 60-ton gantry crane used in ship construction. Built by Herbert R. Pfister, of New York City, it has a miniature block-and-fall arrangement capable of lifting objects weighing several pounds. Hand cranks on the cab control the boom and raise or lower the block and whip. The model, held close to scale dimensions, is chiefly wood, but sheet metal was used to reinforce points of strain.



A TOY KITCHEN CABINET that Frank B. Baker, of Raleigh, N. C., built for his granddaughter is complete in every detail. As the photograph at the left suggests, it closely resembles a full-size cabinet. It stands 36″ high and is 20″ wide. When completed, it was given a white enamel finish.

MACHINED IN 17 PIECES, this ⅛″ to 1″ scale model of the crankshaft used in a Wright 14-cylinder Cyclone engine stands 4½″ high and weighs 4½ oz. Al Vitt, a tool designer for the Ohio Crankshaft Company, machined it on a screw-cutting lathe in his basement workshop. Keeping dimensions to half a thousandth of an inch, he spent more than 400 hours on the job. Front and rear splines were formed with a ½″ diameter dental grinding wheel rigged in a hand grinder. Oil holes were made with needle drills.



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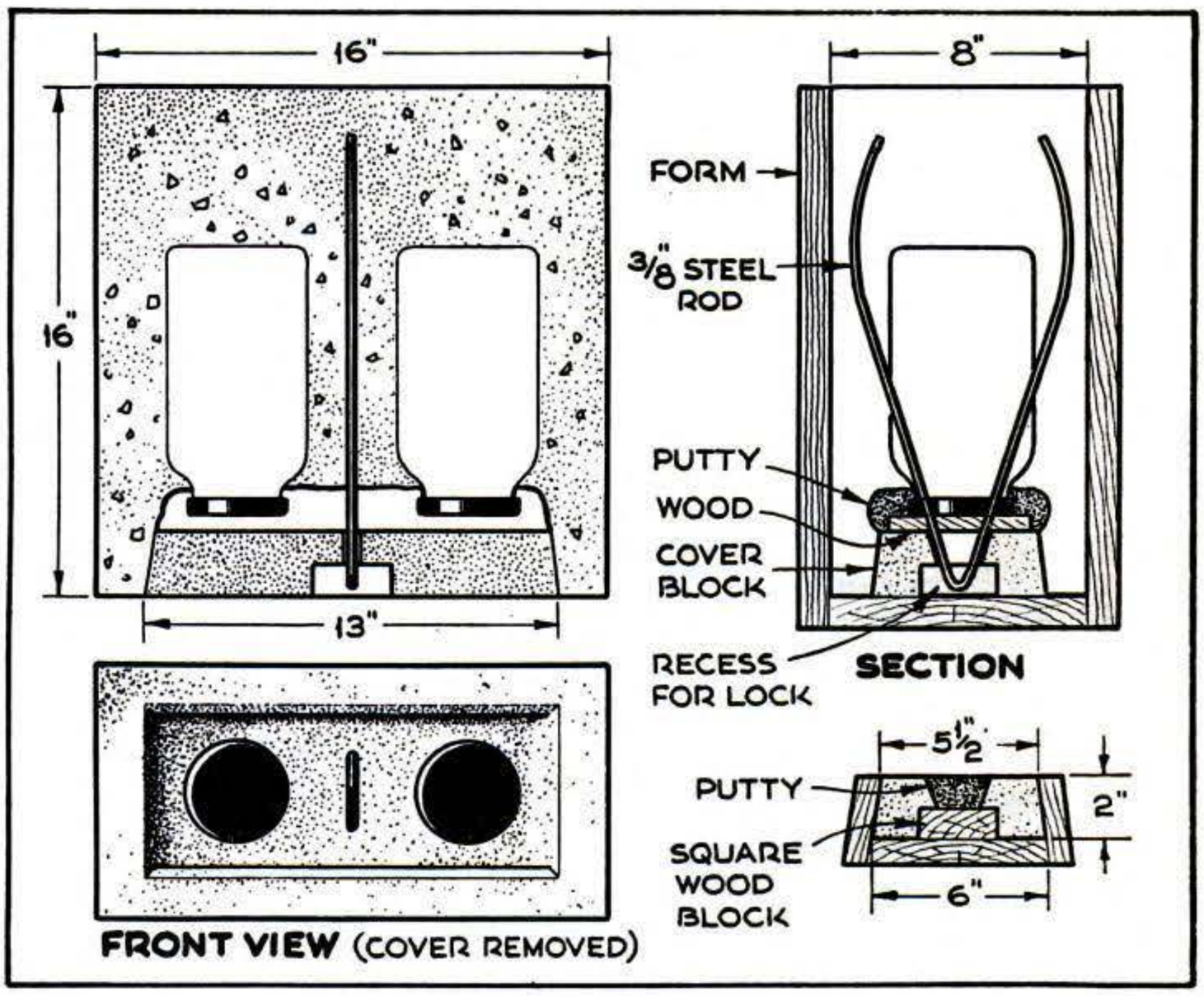
Placed in the basement wall, this safe may be hidden from intruders by suspending some object over it.



Home Vault Guards Valuables from Theft, Fire, and Dampness

SAFE storage for valuables may be provided by casting wide-mouth jars in a block of concrete and substituting this for a stone or building block in the basement wall. Screw-capped chemical bottles in the 5-lb. size are excellent for this purpose.

The vault illustrated here was designed to replace a standard 8" by 8" by 16" cement building block, the extra 8" depth extending back into the surrounding earth. A loop of ⅜" steel rod cast in the main block projects through a slot in the cover to allow a padlock to be attached. A recess on the face of the cover accommodates the lock.

After being cast in a wood box with tapering sides, the cover is wrapped in wax paper and used as the core for forming the opening in the main block. This assures a tight fit. A square or round block of wood centered on the bottom of the cover form takes care of the lock recess, while putty gives clearance for the jar caps. Wire laid in as the mold is filled reinforces the block. A rich cement mixture (1:1) is best.

Black Lines Show Color as Benham Disk Revolves

C. E. BENHAM started something when he discovered this optical effect back in the 1890's. The disk at the right is ready for your scissors. Snip out the pattern, glue it on a piece of stiff cardboard, and mount it on a nail or pin so that you can spin it at a moderate speed, like a slow top. (Don't spin it as fast as you can, since the illusion is weakened and ultimately disappears at high speeds.)

As it turns, the black lines take on colors. When spun clockwise, the disk shows a reddish-brown inner circle, with concentric lines of greenish yellow, gray, and brown. Reverse the rotation and the colors reverse. Benham didn't explain this. Readers who think they have a sound, scientific explanation are invited to share it.

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Drawing Desk for the

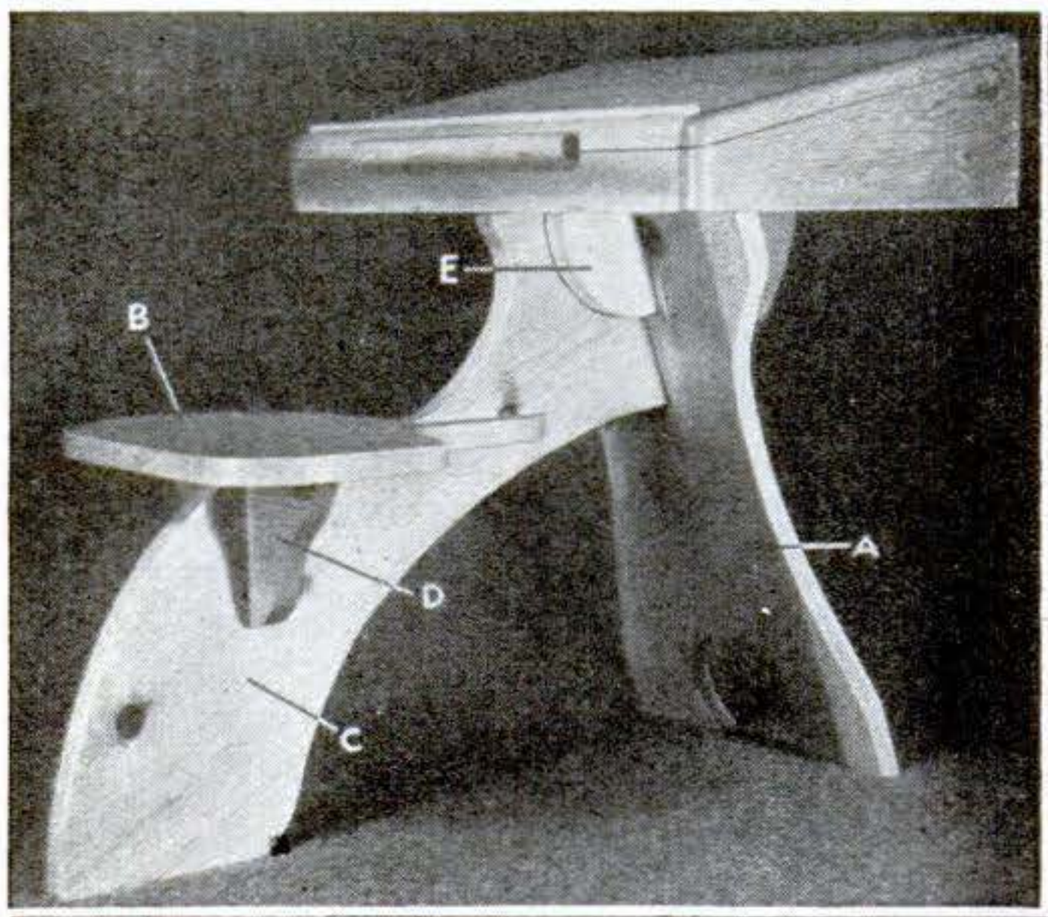
By LECIL J. SLABACK

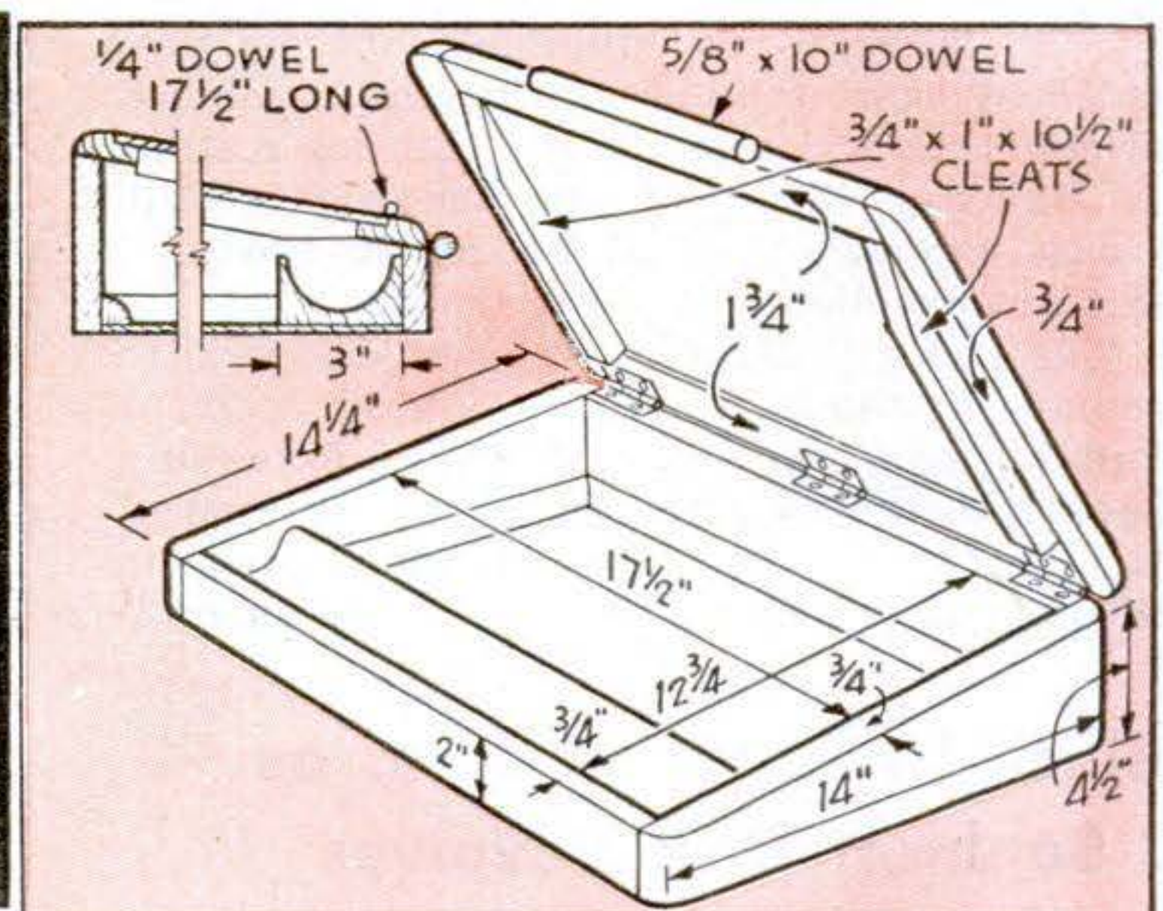
RIDING his hobby at a table and seat he can straddle like a play horse, a child will enjoy this combination from the time he first tries to use crayons. A unit-type desk and stool will please parents as well, for the streamlined design gives a free-flowing appearance in keeping with the modern nursery. Water colors and pencil and crayon marks can be removed quickly from the washable linoleum top.

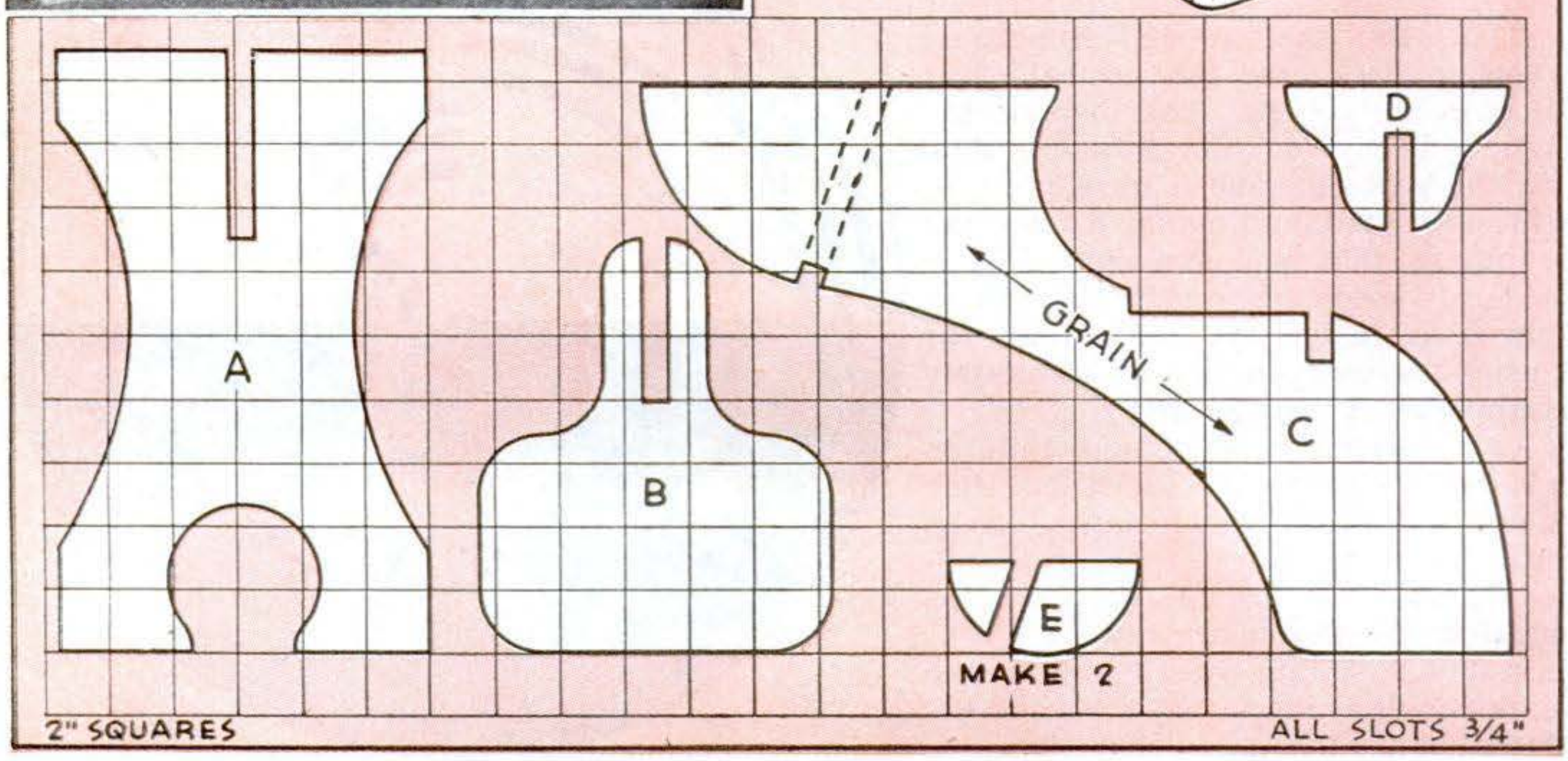
The pieces marked *B, D,* and *E* are cut from short lengths of ¾" by 12" pine. Leg *A* and seat *B* are just about the width of dressed boards of that size, while part *C,* if laid out with the grain running in the direction indicated, can be sawed from a 33" length of the same stock. Slots should be cut a close fit for the mating pieces. Sand all the parts smooth before assembling with glue, wood screws, and nails.

Cut the sides of the desk box from ¾" pine or fir and assemble with dowels and glue. Shape a crayon tray from a 2" by 3" by 17½" piece of soft wood, and glue and nail it and three pieces of quarter-round molding ¼" from the lower edge to form a rabbet for the plywood bottom. The shaping of the tray can be done quickly by cove cutting on the circular saw, as shown in the small photo on the facing page. Progressively deeper cuts are taken with the piece sliding along a wood fence clamped at an angle to the blade. This angle can be determined by sighting along the fence over the saw blade.

The frame for the lid is made up from two ¾" by ¾" by 14¼" strips for the sides and two ¾" by 1¾" by 17½" for the front







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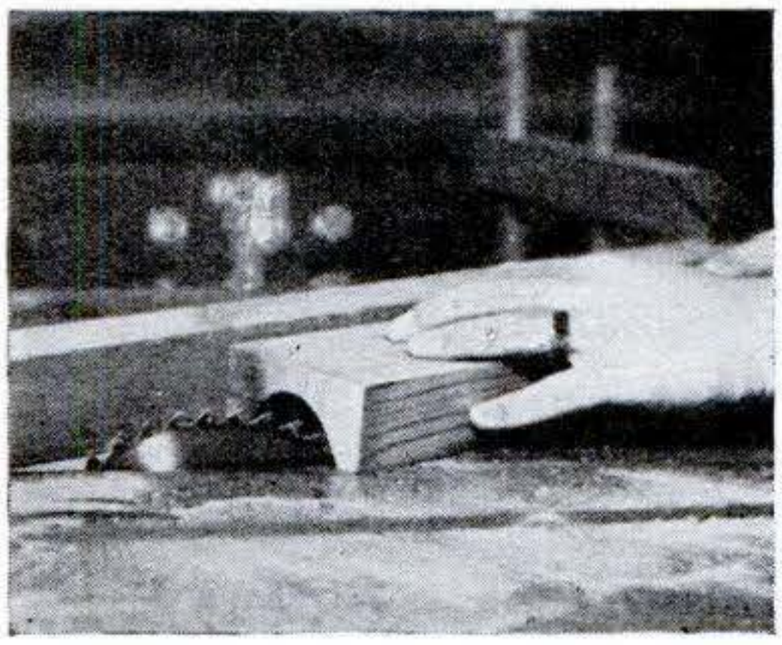
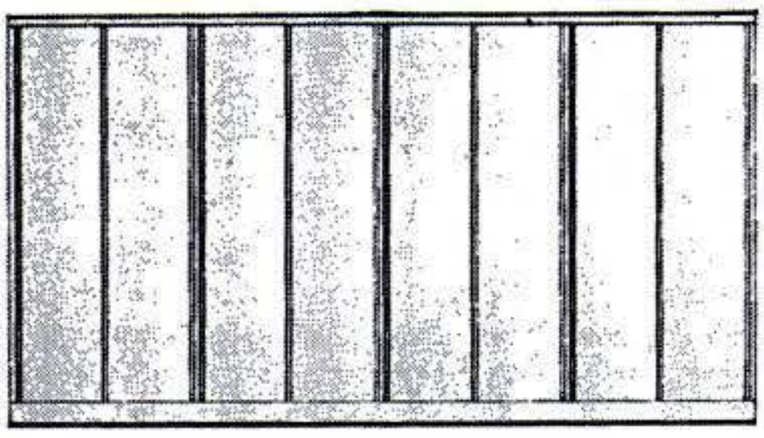
Playroom

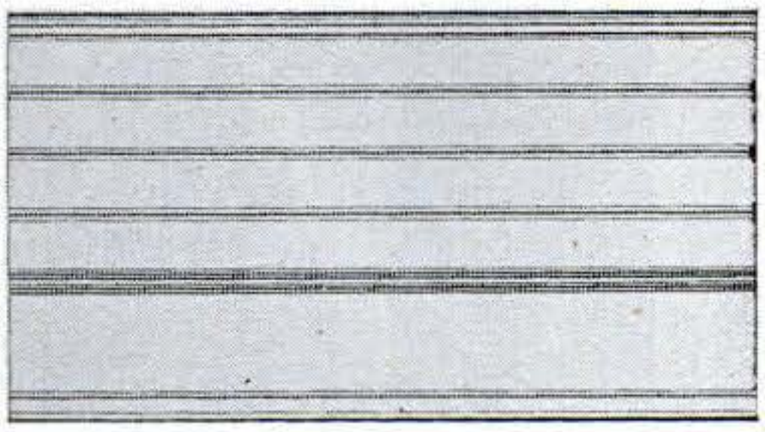
and back. Rabbet the latter two 5/16″ by 1″ to take a ¼″ top panel of plywood or composition board to which the linoleum has been cemented. The rabbets are formed on the sidepieces simply by gluing and bradding on cleats cut on a slant to clear the crayon tray. A chain can be added to prevent opening the lid too far.

Two long dowels through the bottom of the crayon tray and the top of piece *C* will anchor the desk box safely on top of the stand. It will be desirable also to put two screws through the plywood bottom into piece *A* and a long screw or finishing nail through the back molding into the piece marked *C*.



USE OF PLYWOOD FOR WALLBOARD [WOODWORKING]





Moisture-resistant three-ply ¼″ or ⅜″ thick is used in most residential interiors where wallboard is not subject to weathering or high humidities. Installed with tight joints, this wallboard can be stained and varnished, finished bright (natural), painted, or papered. Calked joints are suitable for painting and papering. Tight joints require such mounting on the frame as will allow for slight shrinkage movement of the frame, and adjustment joints are needed at the ceiling, floor, corners, and openings.

Joints covered with batts or moldings are left open to allow movement. For such installations, as well as for open joints that are part of the decoration, it is a good idea to plan for best appearance by grouping the panels for grain, space balance, and the like. Vertical joints and vertical grain tend to make the ceiling seem higher while apparently reducing the length and width of the room. Horizontal joints and grain reverse the effect.

While plywood is especially adapted to modern flush effects, and handsome hardwood surface veneers are obtainable, traditional treatment such as the use of picture moldings, cornices, chair rails, and scoring to represent random-width boards is feasible.

POPULAR SCIENCE MONTHLY SHOP DATA

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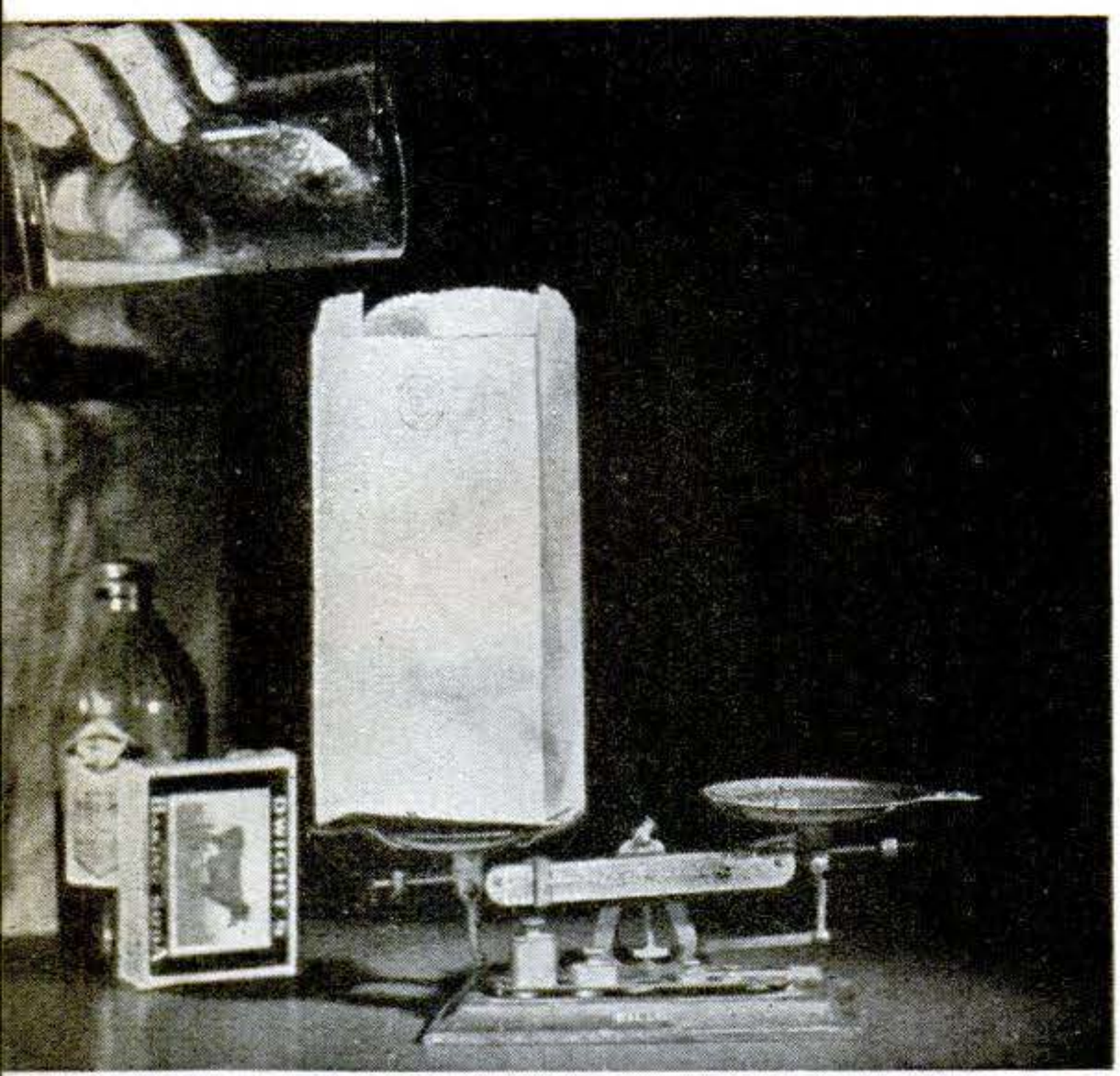
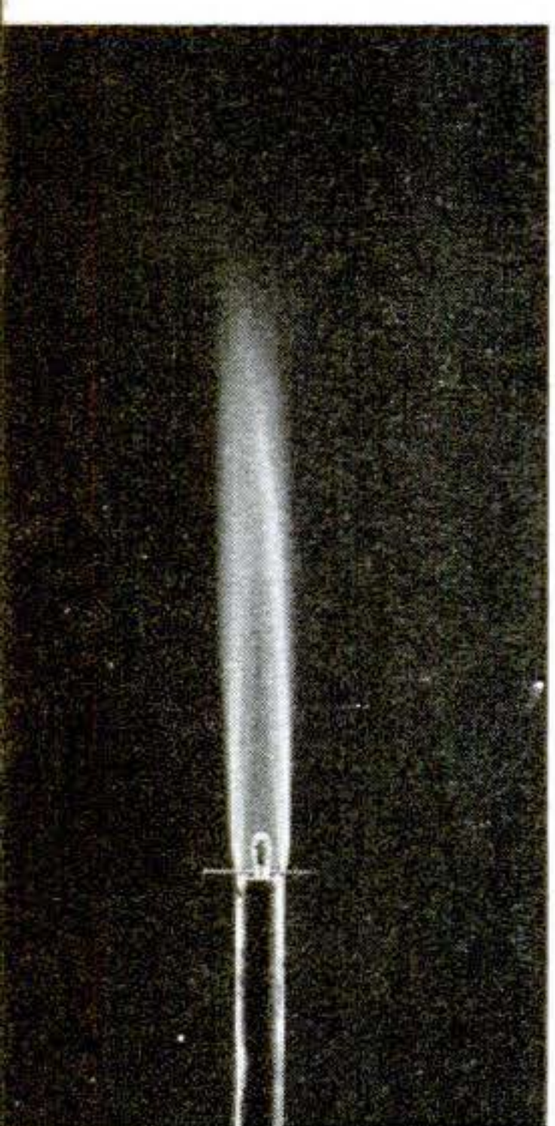
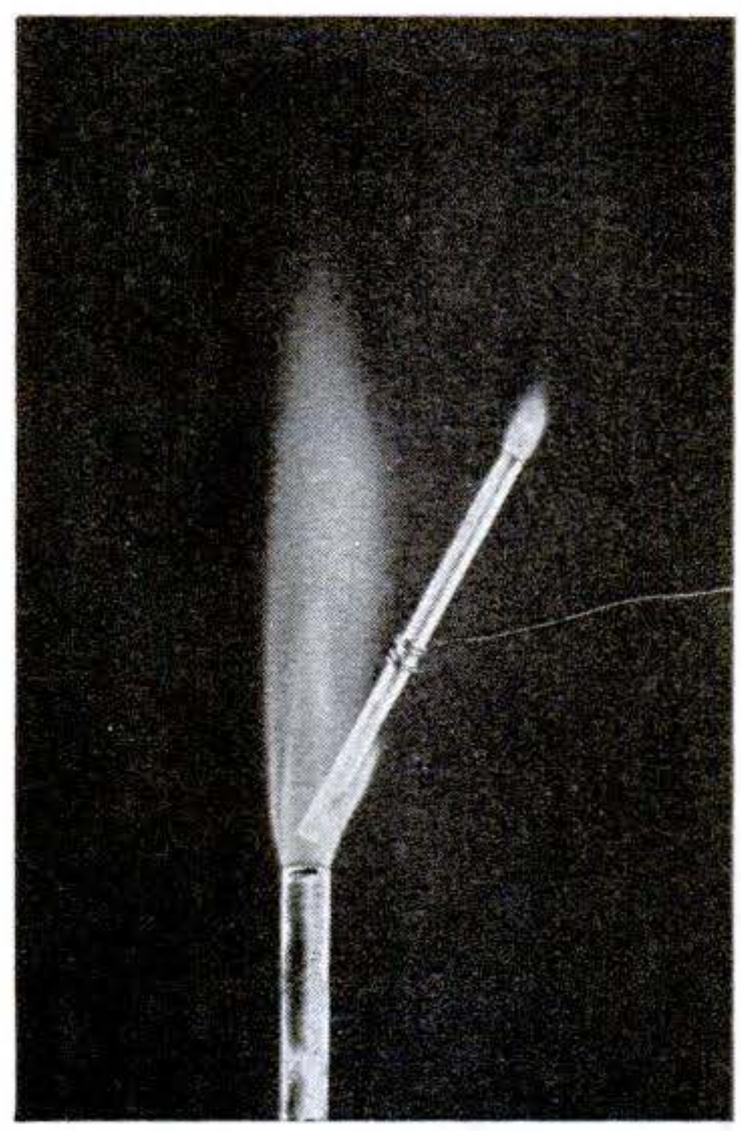


GASES HAVE WEIGHT. In case you think they don't, that they are a sort of ethereal nothingness, you can dispel the idea by making some carbon dioxide gas, pouring it out of a glass as you would water, and weighing it on a scale. A photographer's scale, sensitive to a grain or so, will serve for the weighing. Get a paper bag with a capacity of about a pint, open it, and carefully balance it on the scale. Make some gas by putting a little baking soda in a big tumbler and adding a small amount of vinegar. Allow a few seconds for the gas to be generated. Then lift the glass, keeping it carefully upright until in position to tip it over the mouth of the bag as if you were pouring water. You will see none of the gas during this procedure, but the scale will dip perceptibly, indicating that something heavier than air has been generated and has gone into the bag.

BUBBLE DANCE. The presence of invisible vapors that are heavier than air can be demonstrated with soap bubbles. Put several teaspoonfuls of carbon tetrachloride (a noninflammable cleaning fluid will do) into a large pan or basin. Place the pan in a spot free from drafts and allow it to remain undisturbed for 10 or 15 minutes. At the end of that time, blow some soap bubbles and drop them into the pan. Instead of falling to the bottom of the pan, as they would do if nothing but air were present, the bubbles will bounce about mysteriously as if on an invisible cushion. The heavy carbon tetrachloride vapors support them.



SOME FLAMES ARE COOL at the center. You can show this by pushing a pin through a wooden match right below the head, and suspending the match inside the tube of a Bunsen burner, as shown at the left, centering it as accurately as possible. Then turn on the gas and ignite the burner by holding a lighted match several inches above it. Although the suspended match seems bathed in hot flame, it will not ignite for many seconds. You can discover why by supporting a short glass tube diagonally so that its lower end dips into the inner cone of the flame, as at the right. Hold a match to the upper end, and you will have a second burner. This is fed from the inner cone—a mixture of gas and air moving at too high a velocity to get hot enough to burn.



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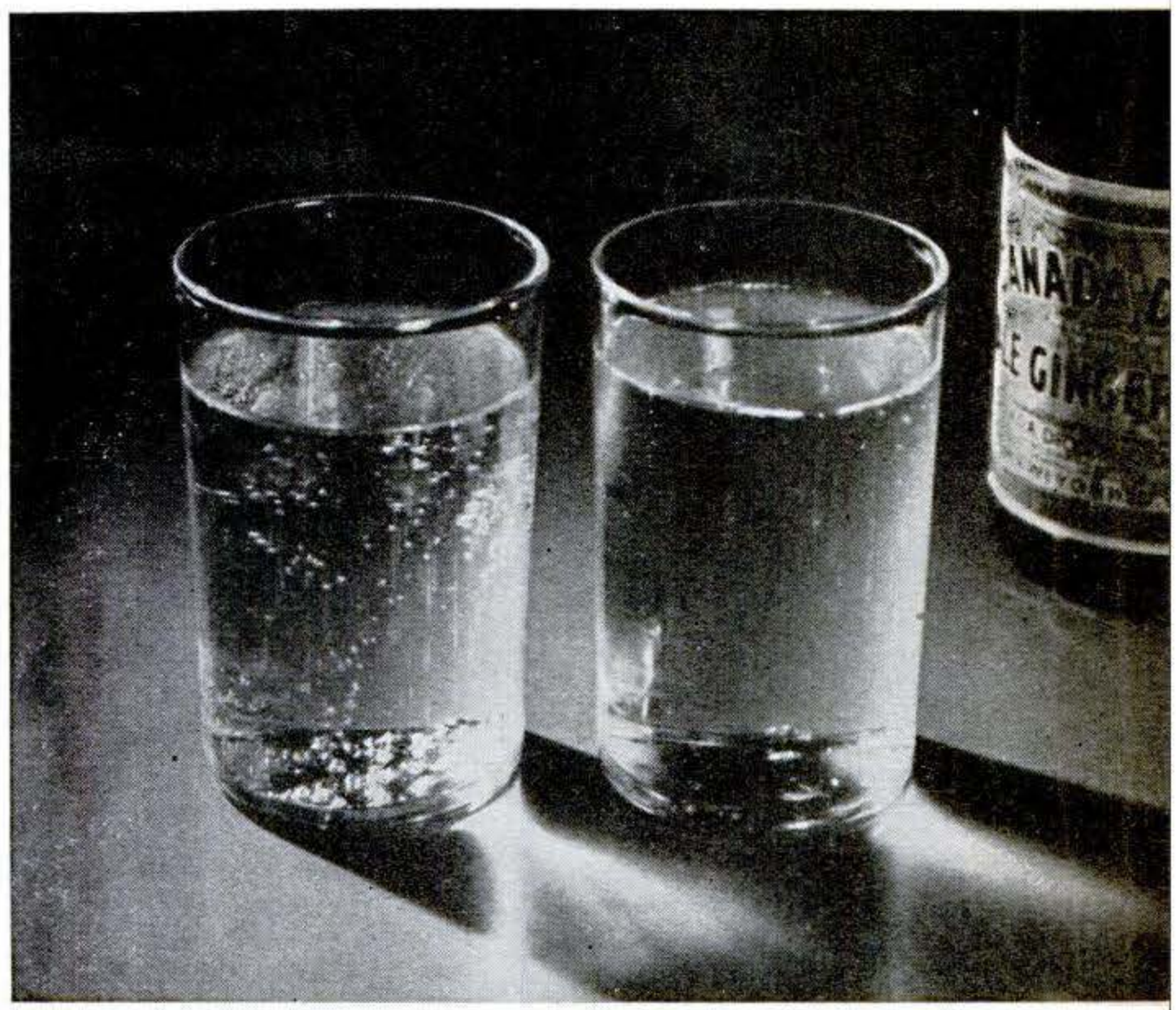
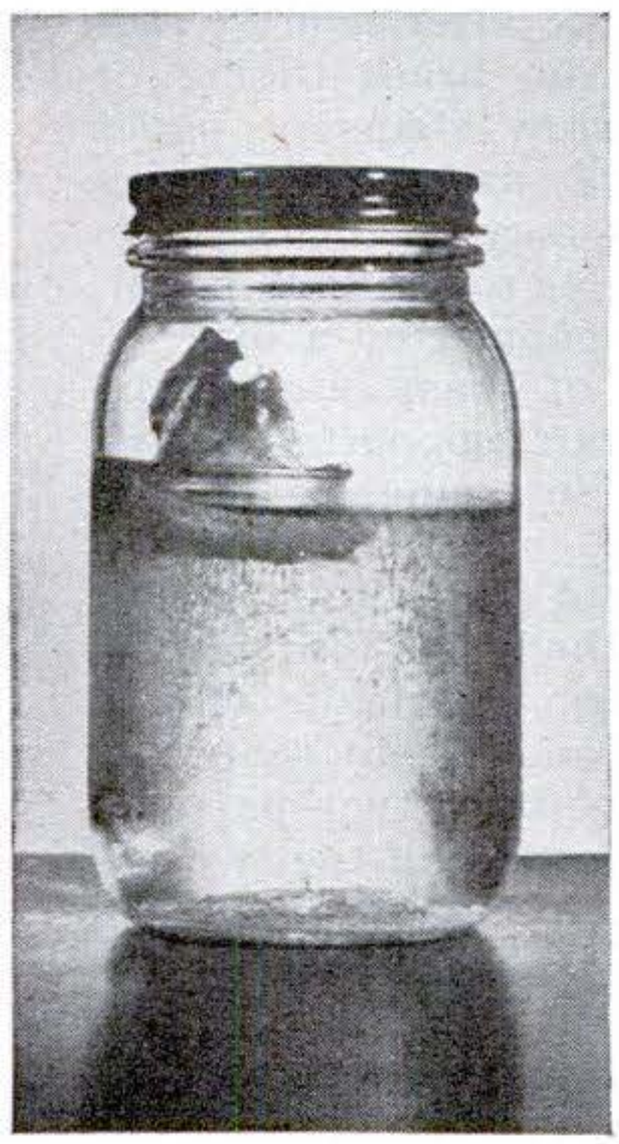
MYSTERIOUS BEHAVIOR OF GASES

AIR EXERTS GREAT FORCE, but we ordinarily are not aware of it. By using a flat rubber sink stopper, you can harness this force, or atmospheric pressure, and make it help lift a kitchen stool. Tie a cord to the ring of the stopper, wet the flat top of the stool with water, and press the stopper firmly down. If you now lift straight up on the stopper, the stool goes along. The water keeps air from getting between the flat surfaces of the stopper and stool. Consequently, air pressure holds them together as if they were glued.

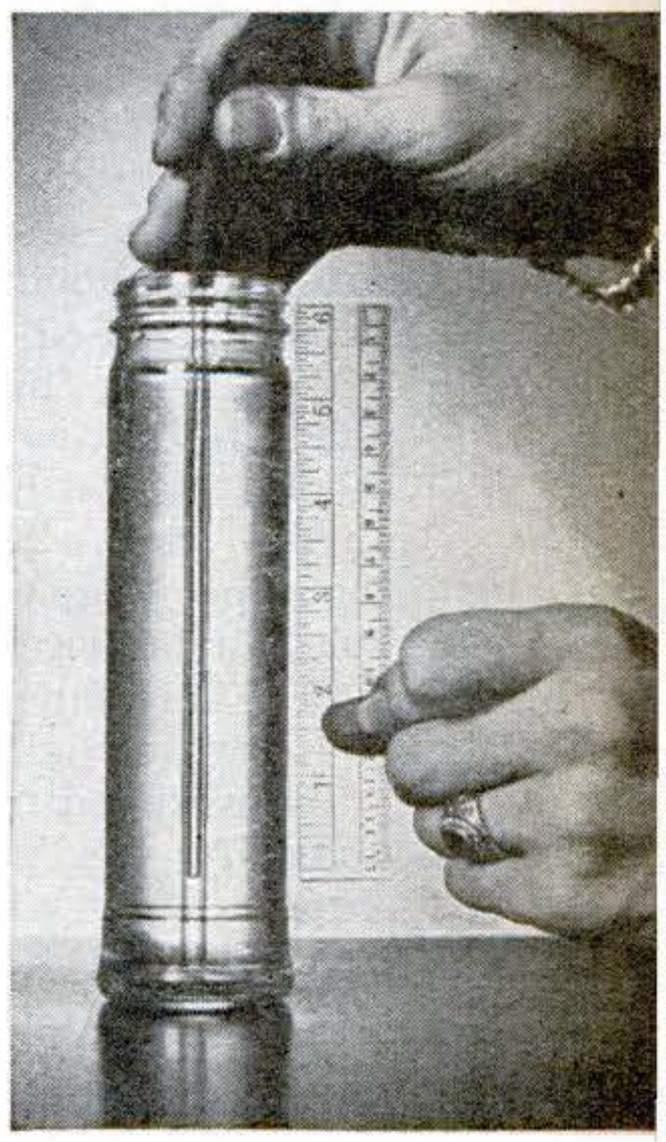


WHICH GLASS WAS TOUCHED? Soda water can be used to perform a mystifying trick. Clean two similar glasses by washing in hot water with a soapless detergent such as trisodium phosphate, rinse, and allow to dry without wiping. Turn your back and ask someone to rub a finger on the inside of the bottom of one glass. Now pour soda water in both, and a great number of carbon dioxide bubbles will rise in one. You name this as the one that was touched. Why? Because molecules of carbon dioxide in soda must clump together to form bubbles. Any bit of foreign matter, even natural oil from a finger, speeds the process.



ATMOSPHERIC PRESSURE helps hold carbon dioxide in soda water when it is uncapped. You can demonstrate this by filling a screw-cap jar two-thirds full of soda, floating a small cap on the surface, igniting a piece of paper on this "raft," and quickly screwing down the jar cover. As the oxygen is consumed, the pressure above the soda is reduced. This will be evidenced by a more rapid flow of bubbles.

HOUSEHOLD GAS PRESSURE can be measured by connecting a straight glass tube to the supply with rubber tubing, standing the glass tube in a water-filled bottle, turning on the gas, and then measuring the distance that the water level in the tube is depressed. This measurement indicates the pressure expressed in inches of water, each inch representing about 0.57 oz. pressure per square inch. This, of course, is in addition to atmospheric pressure.



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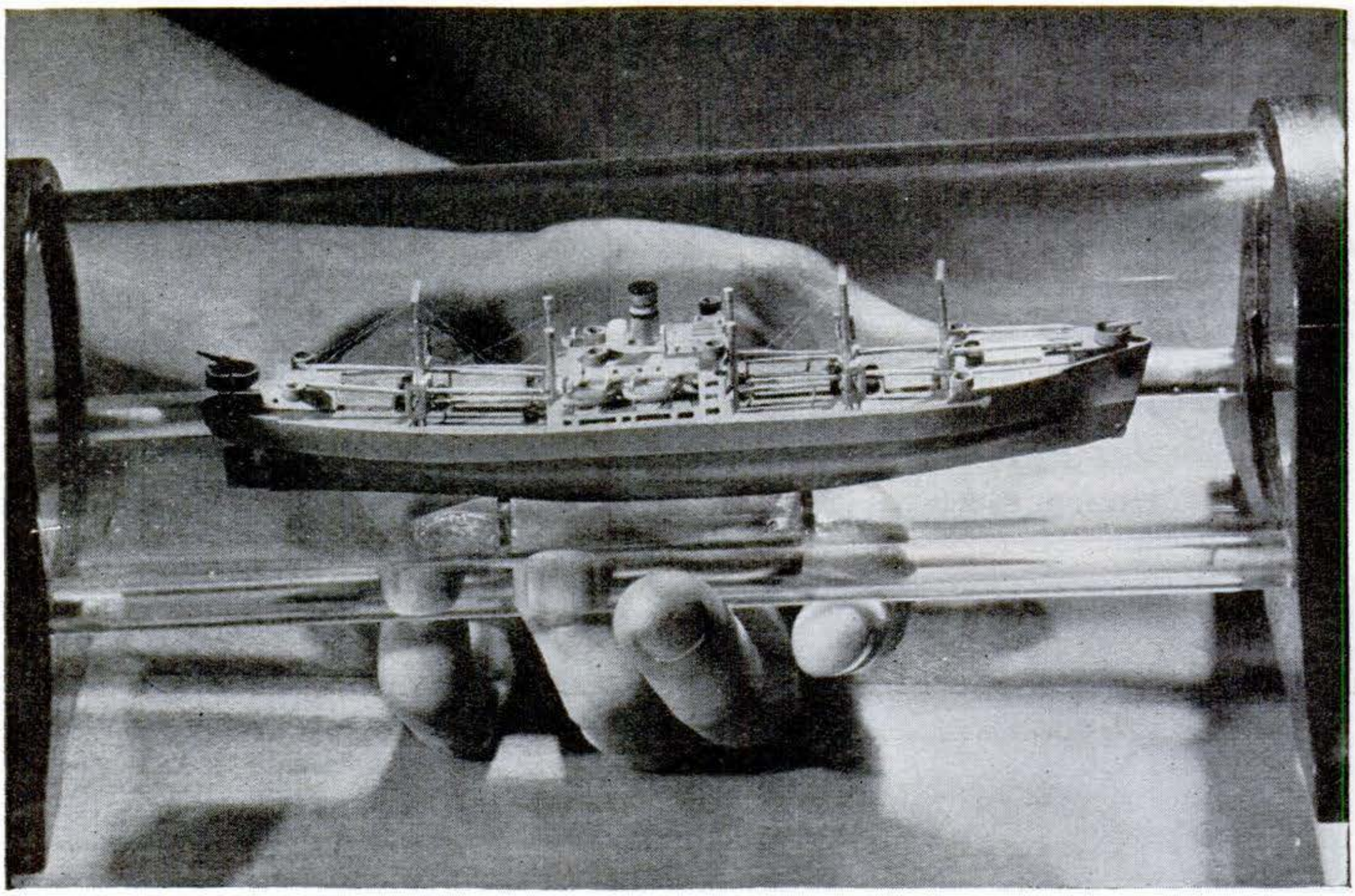

THUMBNAIL MODEL OF A VICTORY SHIP

By E. J. Mooney

MODELMAKERS with a flair for detail will find this little Victory ship an intriguing project. Scarcely larger than the palm of the hand, its scale is approximately 1/64" to 1'. All pieces making up the superstructure of the model may be cut or turned individually from brass, but if you must skimp on time it will be possible to substitute wood and heavy drawing paper. Drawings of all parts are actual size.

In carving the hull from a block of wood, you will notice that the template for the second station from the bow provides for an abrupt rise in the deck. Dotted lines along the upper edge represent the top of the block but the bulwarks are actually rabbeted in below this line. So is the upright piece *A-10,* which is flush with the bulwarks.

Parts keyed from *A-1* through *C* comprise virtually the entire superstructure amidships. They are assembled in the order numbered. Dotted lines on *A-2, A-4, A-6,* and *A-8* show the location of the part that goes on top. In addition, the small holes on these parts are keyed for correct location. Deck houses may be cut from ⅛" wood and the decks above from .020" brass, drawing paper, or celluloid.

Brass pins support the forward gun platform *K,* as well as the overhanging section of the deck *D-2* atop the after house. Turrets *J* may be cut from brass tubing or shaped by rolling narrow strips of paper around a dowel, gluing, and then slipping them off. The stack *G* may be turned from brass, cut from tubing, or rolled from paper, or it may be a dowel capped by a disk.

By soldering sheets of brass into a solid block, the davits *I,* raft supports *V,* and rafts *W* may be made in a single operation for each set. Use .040" brass for the rafts and .020" for the davits and raft supports. Lay out the design on the block with pattern blue or by scratching; then cut with a power jigsaw or drill and file to shape. If you use the latter method, two patterns should be aligned accurately on the two opposite faces. When the shaping has been completed, heat the block and pull the pieces apart.

Masts *M* on this model were turned from brass, the largest section being .050", the

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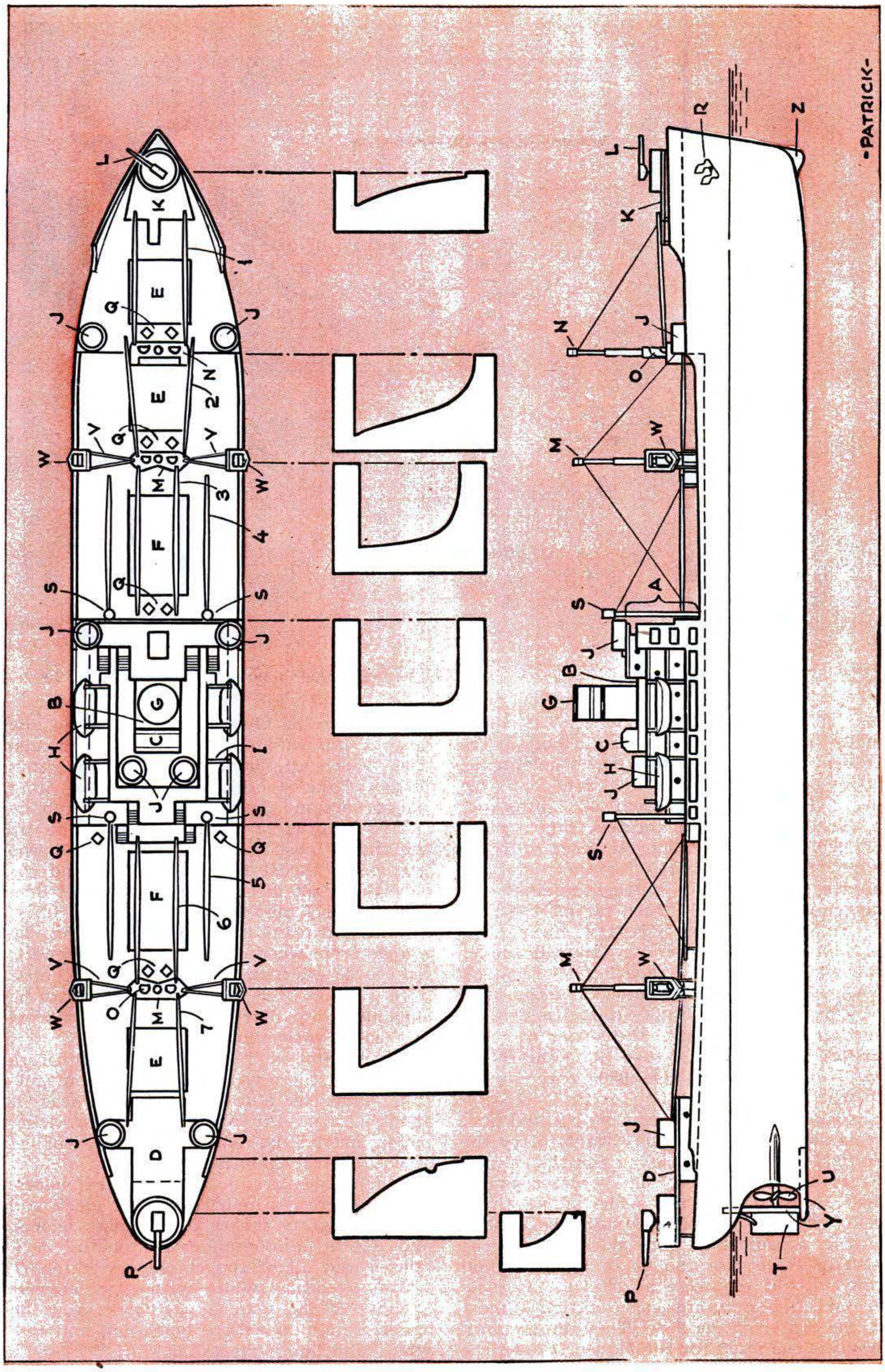

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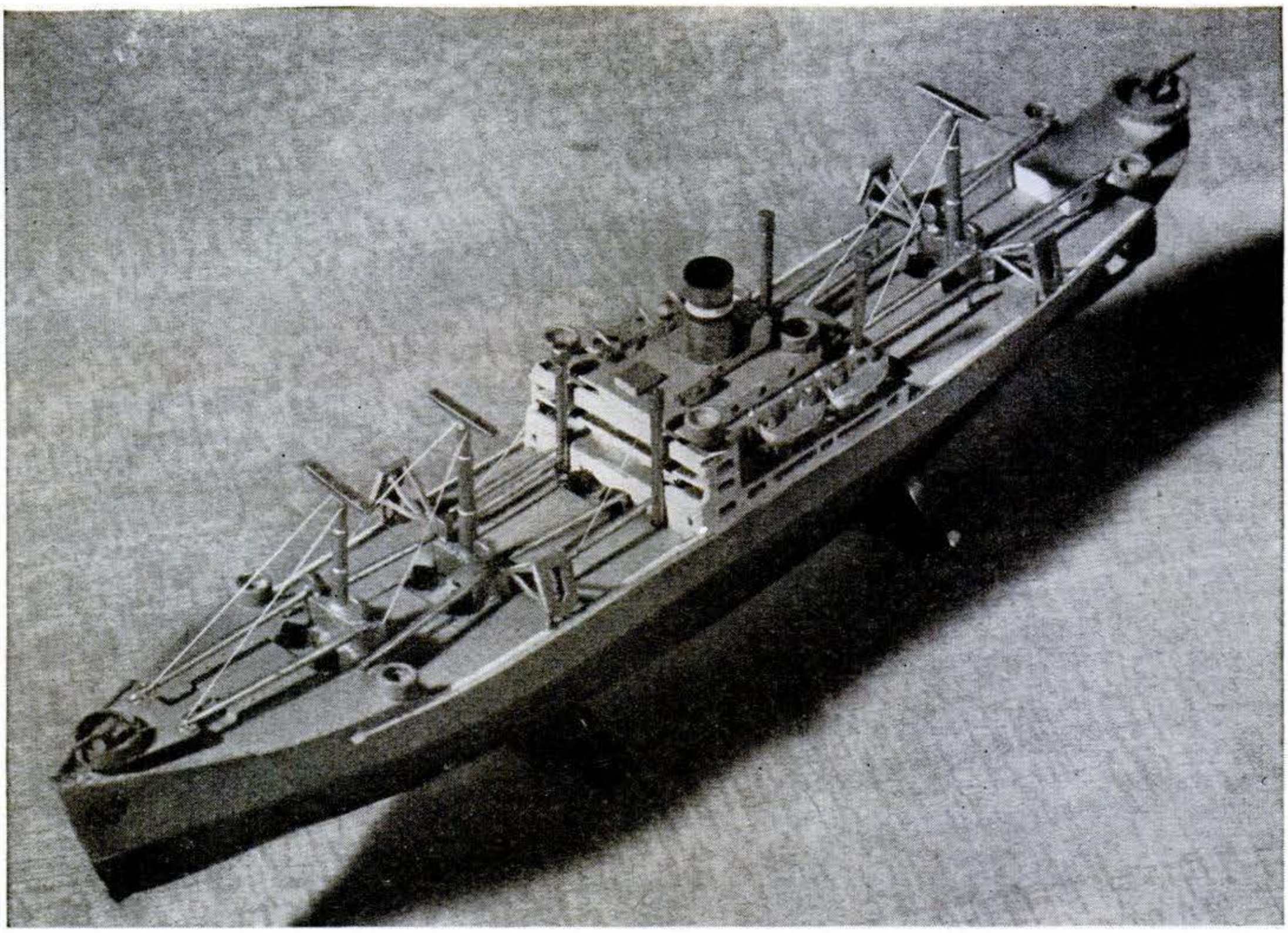

Although less than 7" long, the model has abundant detail, approximately 100 component parts being used.

next .030", and the third .020", The upper end of each was soldered into a hole in the crosspiece and the bottom into a hole in the boom table, which was then pinned to the deck. Booms are cut from .020" brass.

Ventilators *O* were formed from a piece of .020" wire and a shorter piece of 1/16" wire. Solder the wires together at right angles, the smaller butting against the larger near the end. Then file off the rear to give the heavier wire the curve of a normal ventilator, file out slightly under the chin, and slant the face slightly forward.

Guns were made by embedding the head of a brass pin in a large drop of solder, inserting brass wire into the solder at right angles to the pin, and then filing the solder to form the breech. Use .030" wire for the forward gun *L* and .040" for *P*.

Although a propeller can be cut and bent from sheet brass, you may want to try the method that was employed for this model. From a brass rod ¼" in diameter saw a disk 1/16" thick, then solder a length of .040" wire in a hole through the center, letting it project on both sides. Clamp the disk in a pin vise and make four diagonal saw cuts in the edge at 90-deg. intervals around the circumference, cutting almost to the center of the disk. This automatically gives the pitch for the blades. Widen the cuts by parallel filing, being careful to take away a uniform amount of material on each side. When all that remains are four thin blades, shape each like a cloverleaf by filing the corners and the section near the hub.

Two lengths of square brass make up the rudder post and shoe assembly *Y*, the post being thrust up into the hull and the shoe piece set in a notch on the keel line. The rudder *T* may be filed from .030" brass and the paravane *Z* at the forefoot may be shaped from wood or brass. Since thread is too coarse and fuzzy, .0015" (No. 44) copper wire was used for the rigging. This can be cemented into place and may be oxidized or treated with aluminum lacquer.

If you paint each part of the model before assembling there will be less chance of getting paint of a certain color where it shouldn't be. Any parts made of drawing paper should be shellacked and rubbed smooth before painting.

Suggested colors for the model are: waterline, light green; hull, light gray; deck and fittings, slightly darker gray; masts, booms, and davits, aluminum; sides of the deck houses and all of the machinery hatch *C*, white; lifeboats, white with gray covers; anchors *R* and winches *Q*, black; and the stack aluminum with a black top and red, white, and blue stripes.

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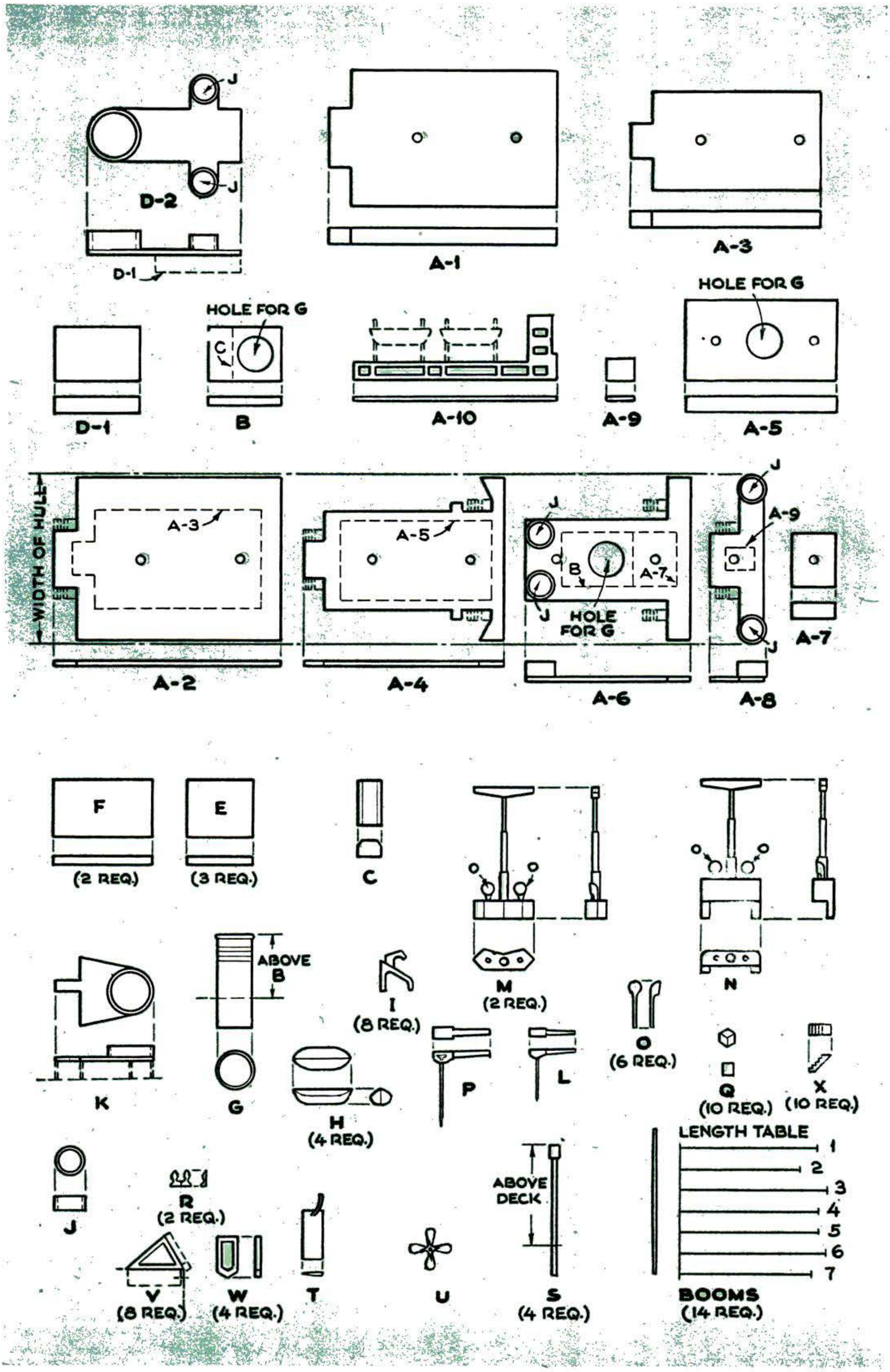

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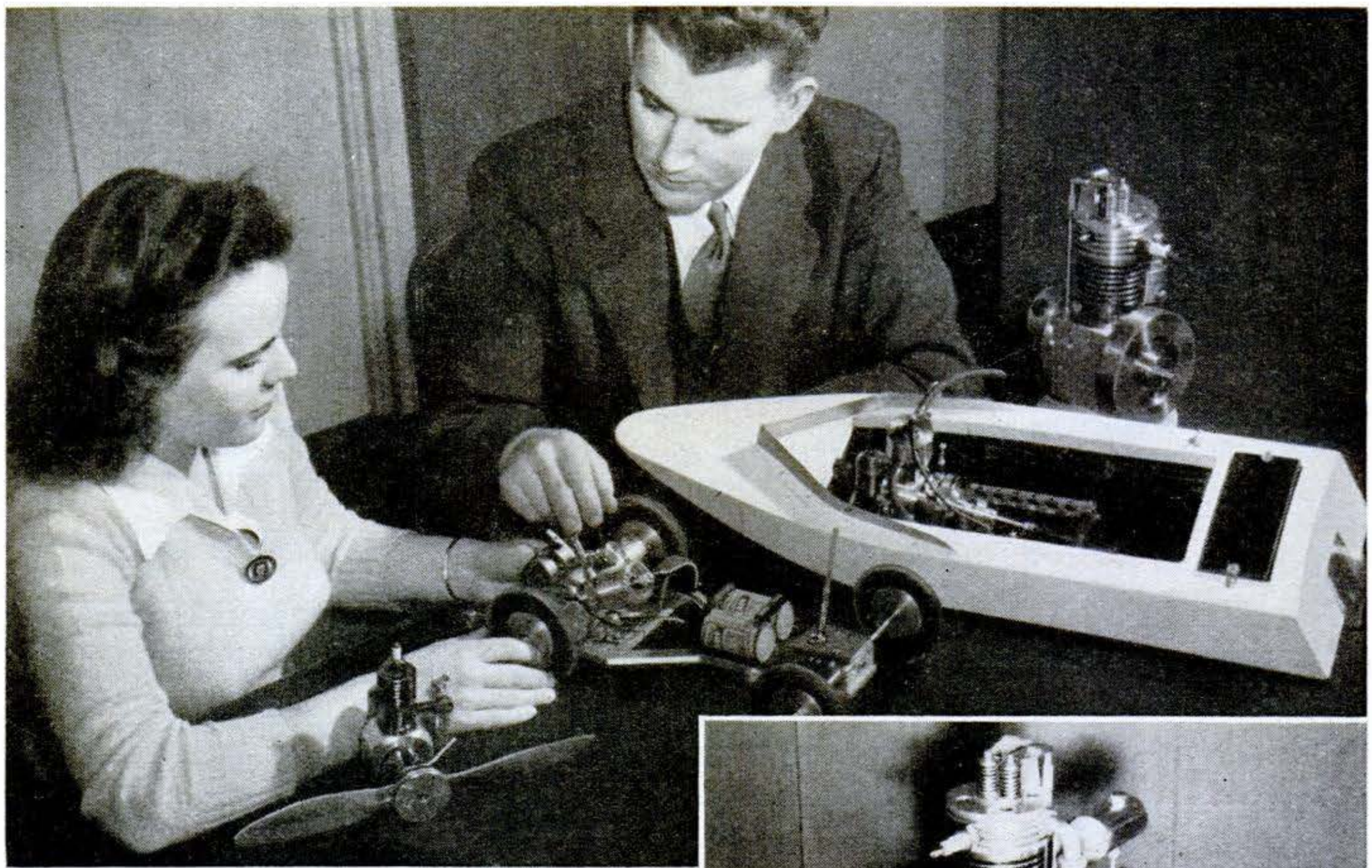
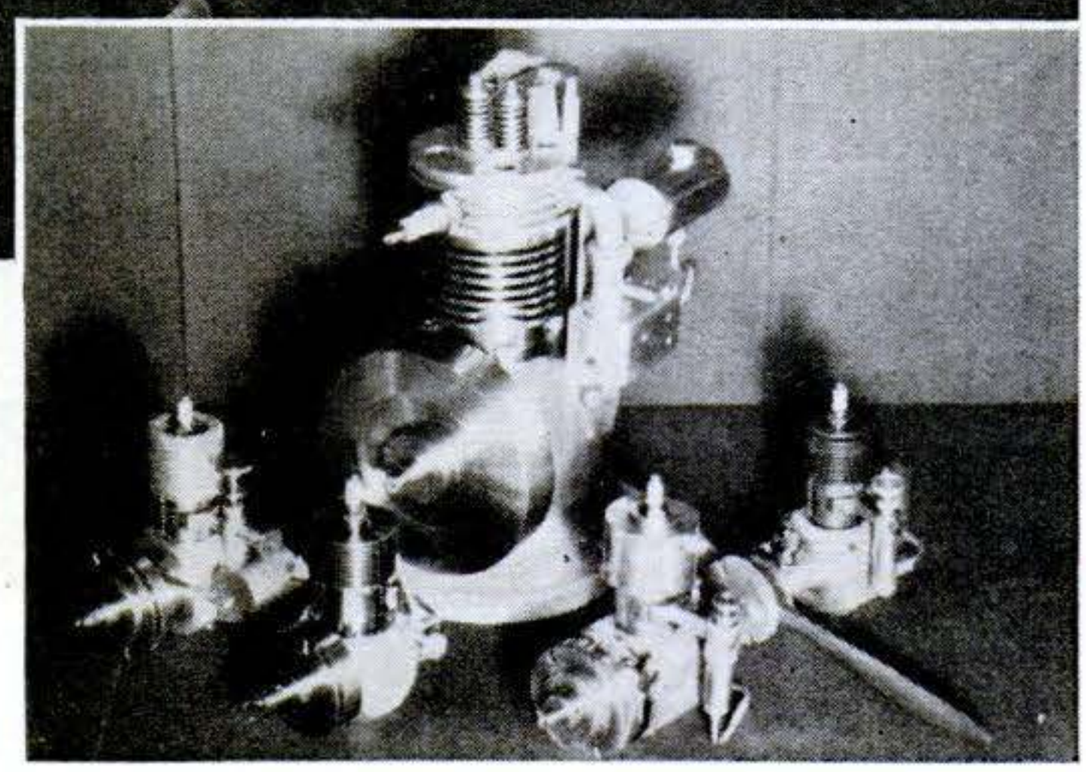
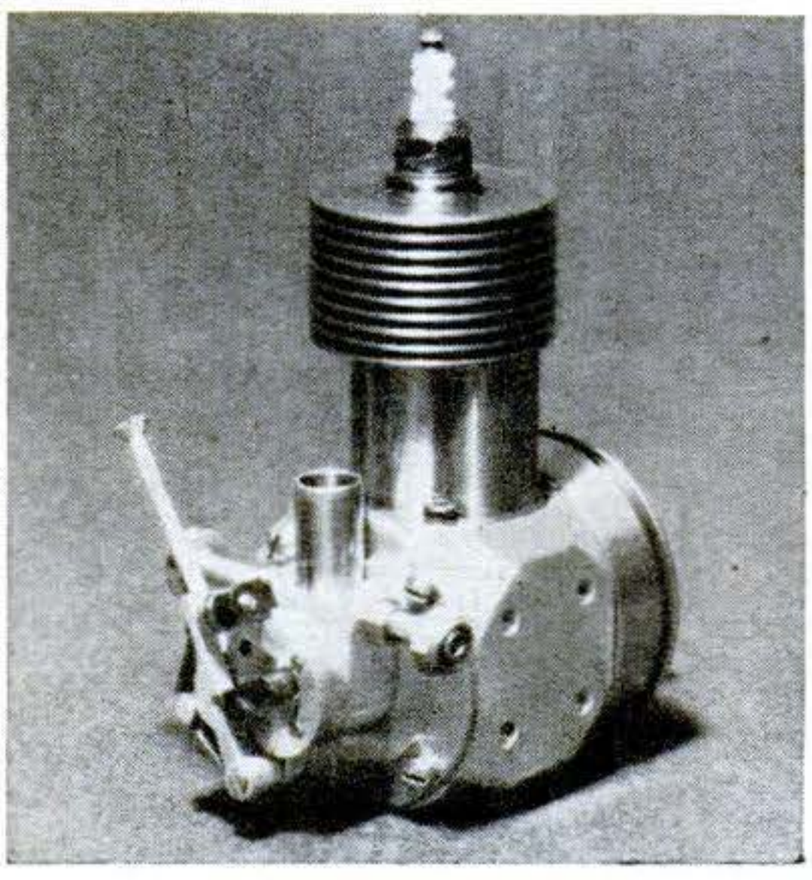


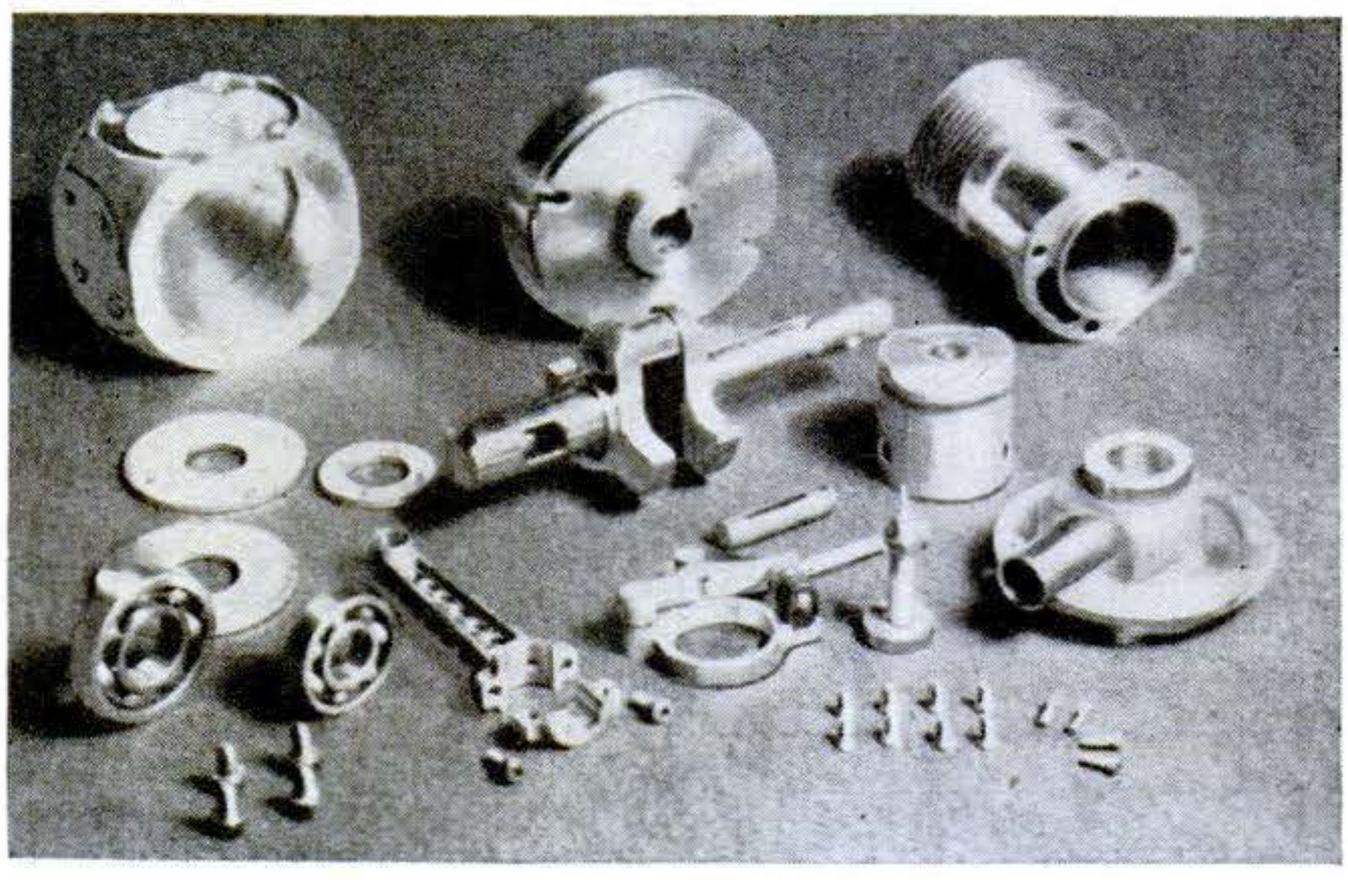


PALM-SIZE POWER PLANTS ARE THIS MAN'S HOBBY

DESIGN engineer, builder, and operator of tiny gas engines that drive model boats and cars at full-scale speed, J. C. Magee, of Schenectady, N. Y., works at a fascinating hobby. The experimental racing car he is shown discussing in the photo above does 65 m.p.h. by actual test, circling around a pole on the end of a 24′ steel cable 1/16″ in diameter. It would travel 95 miles on a single gallon of gas.

The largest engine in the photo at right above was Magee's first. It has a 1⅝″ diameter bore. The others, with bores of ⅞″ and 1″, are small enough to be enclosed in the hand. His latest, shown below assembled and also torn down, is a rotary-valve job that turns up to 13,000 r.p.m. Plans for construction of this high-speed engine, with full machining data, will appear in coming issues of POPULAR SCIENCE MONTHLY. It is an engine that requires no castings.





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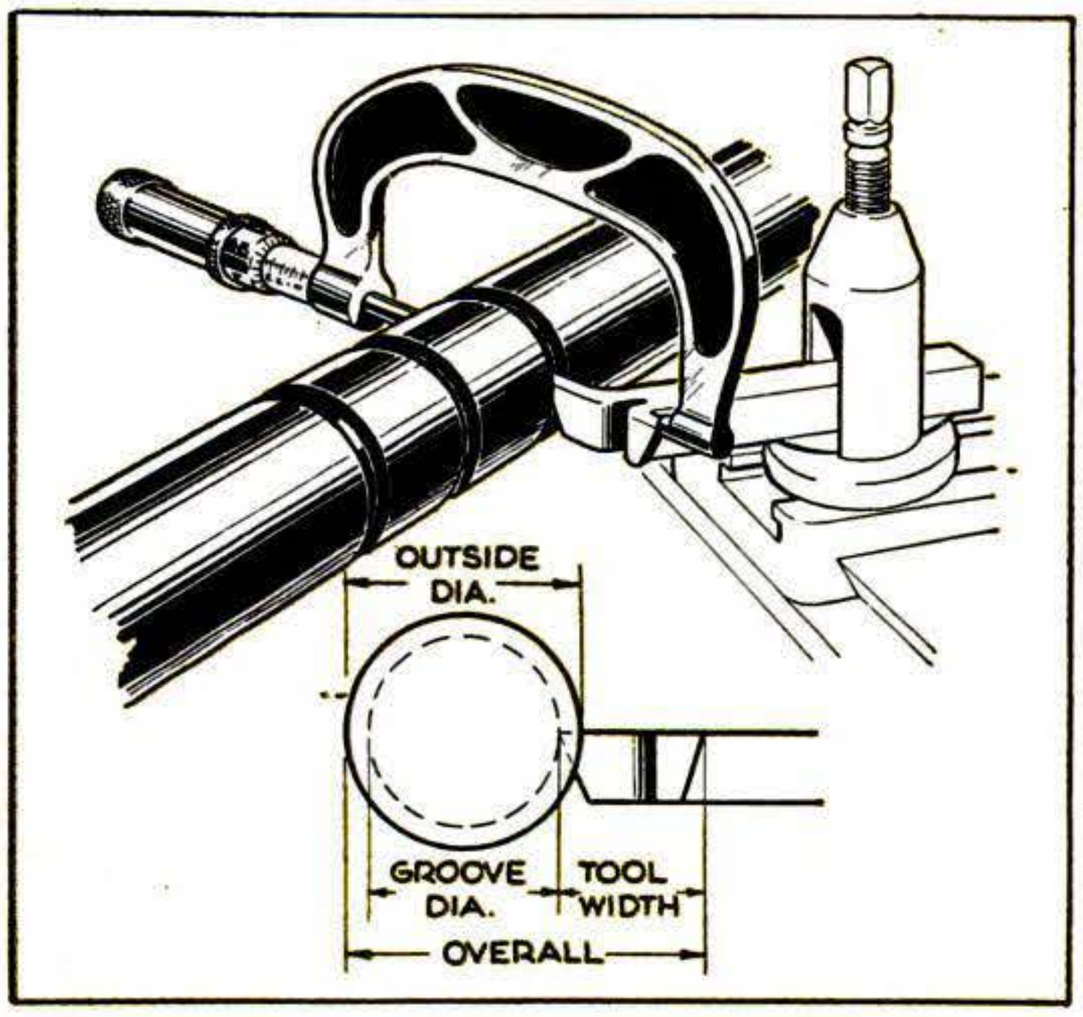
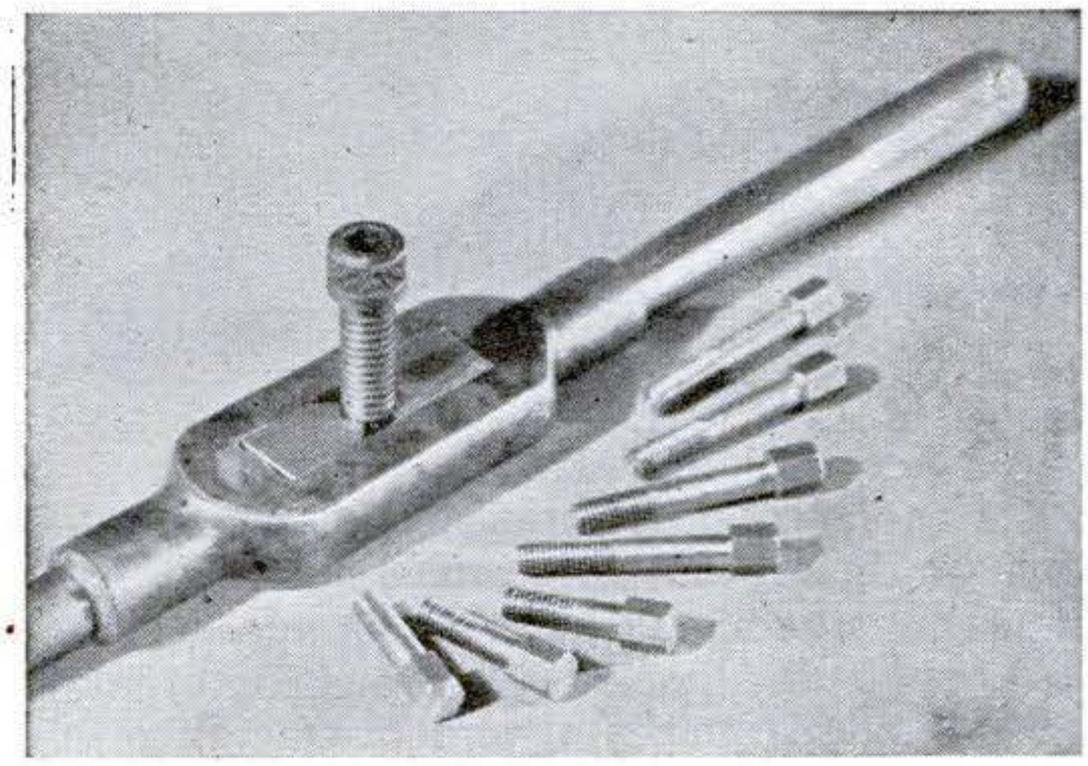
NEW SHOP IDEAS

NARROW GROOVES that cannot be measured directly with a micrometer may be gauged indirectly while being machined with this special tool. It is made by slotting a piece of tool steel, bending the two parts back, hardening, and grinding a cutting edge.

In use, the exact width of the tool is found with a micrometer. To this is added the desired groove diameter plus half the difference between that diameter and the outside diameter of the work. As the tool is advanced to cut, measurements are taken frequently by placing a micrometer across the work and the outer edge of the tool. When this equals the figure previously calculated, the groove has been brought to size.

Instead of making the tool, one might clamp a small block to a standard cut-off tool or to a point on the toolpost or compound rest, taking as the tool width the distance between the edge of the tool and that of the block.—HARRY MOORE.





WHEN A SOCKET WRENCH is needed for small hexagon-head screws, one can be improvised by clamping a hollow-head screw of the proper size in a tap holder as shown here. It also is a simple matter to make a permanent handle by drilling and tapping a short steel rod for the screw, then drilling the opposite end to receive a cross bar. By tightening the screw in the rod and chucking it in a lathe, the head can be turned down thin for use where quarters are cramped.—C. W. WOODSON.

Shop Ideas Continued →

ELECTRONIC HEAT now makes it possible to harden the teeth of a starter ring gear in 20 seconds instead of the two and one half hours previously required. Developed by the Studebaker Corporation, the electronic process consists of placing the gear on a brass fixture inside the field of a two-layer coil. As the gear spins at 75 r.p.m., high-frequency current reverses the magnetic field of the coil 540,000 times a second, raising the teeth temperature to 1,500 deg. in 13 seconds. Then the gear is quenched with water.

Electronic hardening of gear teeth requires only 20 seconds, 13 in the heater at left and seven under a water spray, right.

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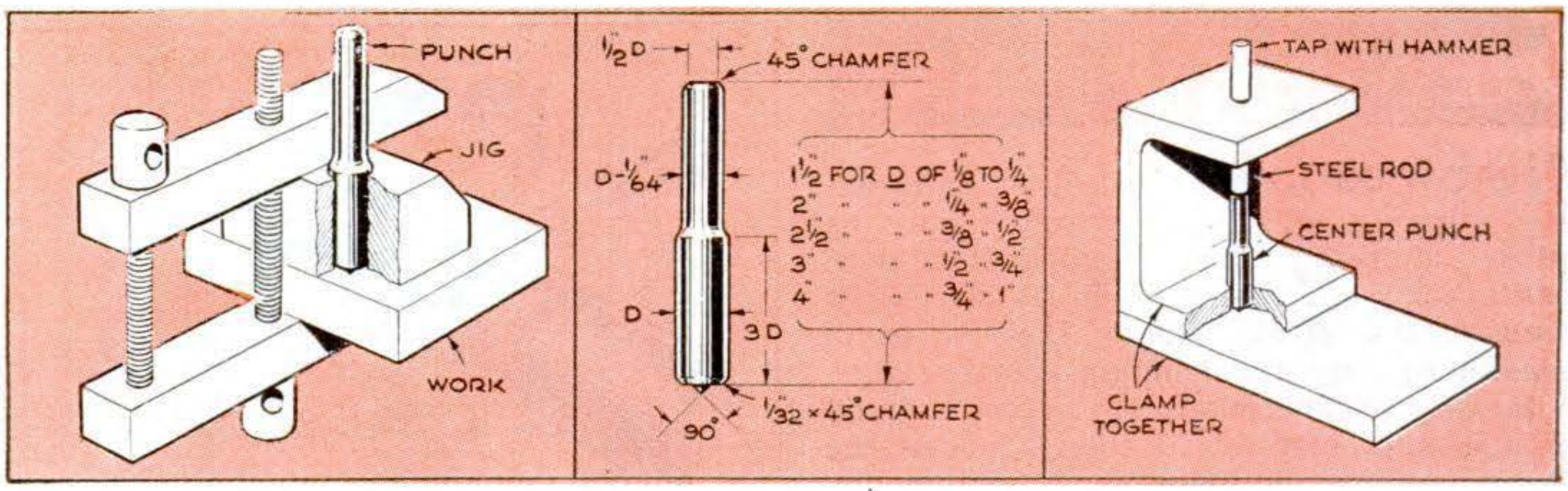
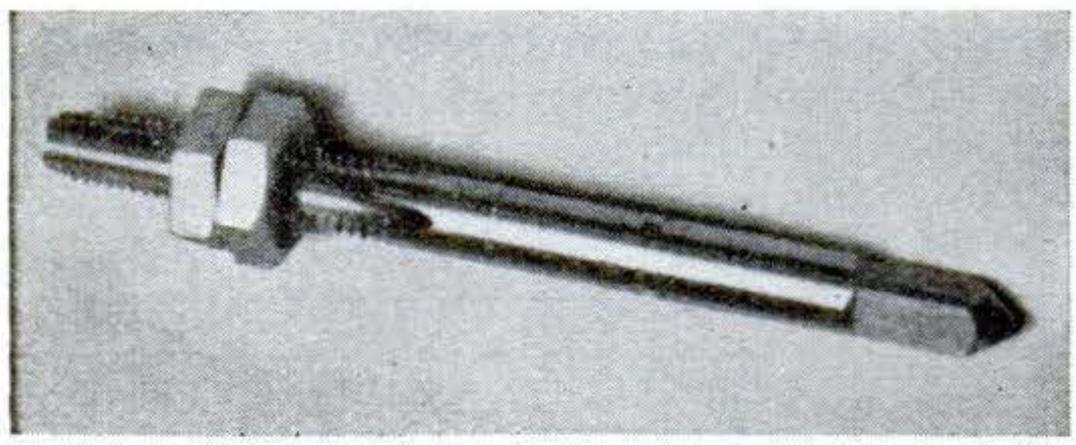
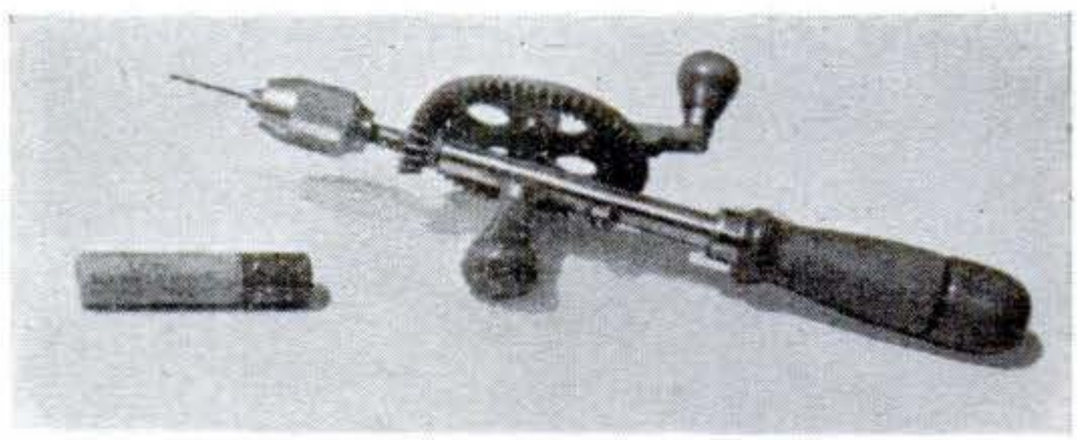


SPOT-DRILLING HOLES so that they are perfectly located in relation to those in another part of an assembly is frequently impractical because of cramped space or awkward shapes. This difficulty may be overcome with special center punches made up in standard drill sizes.

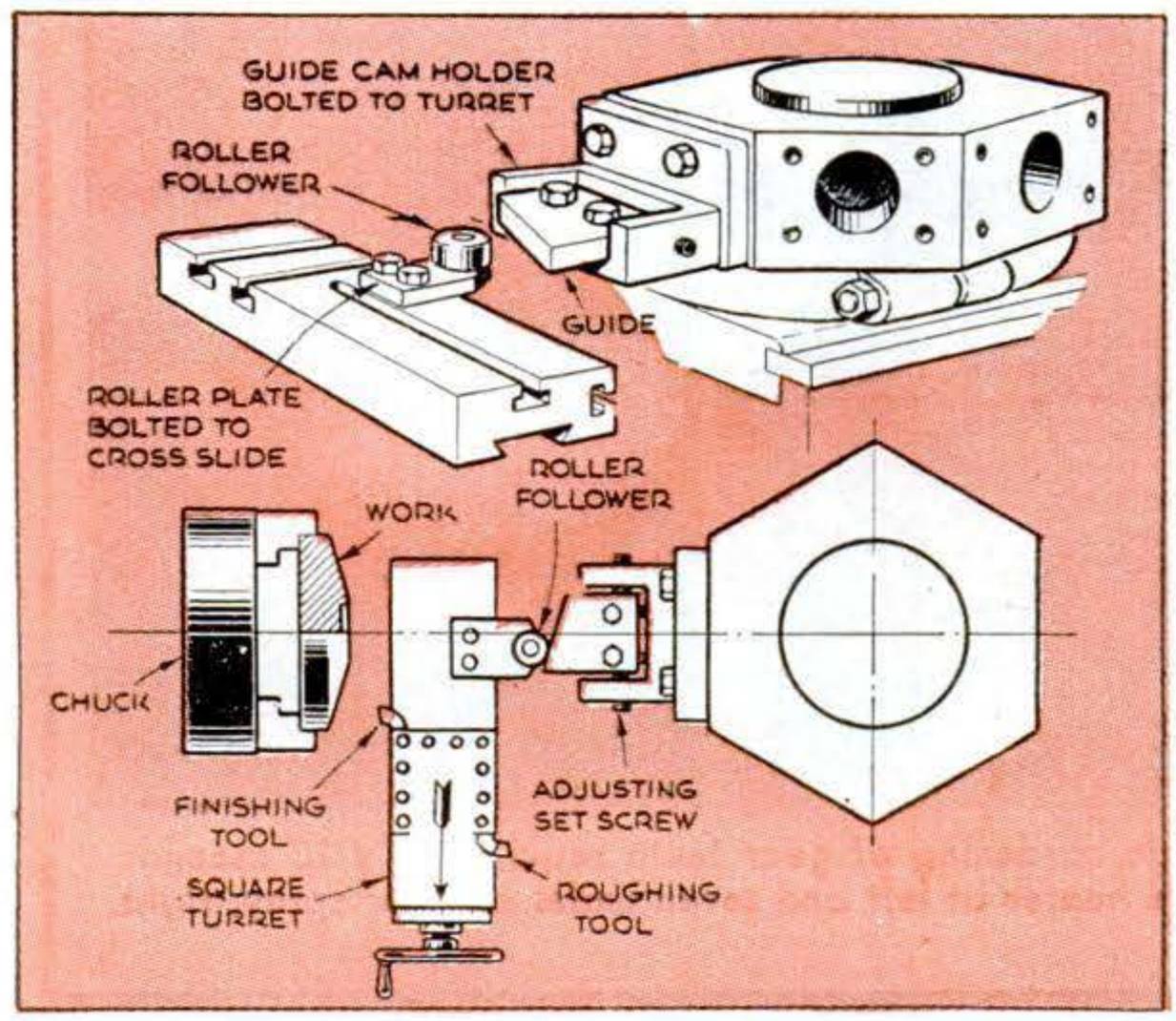
The illustration at the left above shows one of many ways that such punches also can be used where no special problem occurs. In this case, instead of clamping the two parts of an assembly together and spot drilling, a jig was made and used with a punch to spot the holes. At the right is a situation where a projection makes it impossible to get a drill close enough. Such punches also are useful where there is no clearance for a drill chuck.—A. R. PLAMBECK.



TWO NUTS locked in proper position on a tap as illustrated above will serve as a depth gauge when a hole is to be tapped only to a certain depth. This frequently is necessary to prevent tap breakage or to leave a few uncompleted threads at the bottom to insure a tight fit of the screw and provide a vibrationproof assembly.—J. C. M.



LEAD SHOT loaded into the hollow handle of a small hand drill will help keep the chuck from accidentally banging against the workbench and possibly bending or breaking the smaller sizes of drills. One tube of air-rifle shot will fill the average handle and provide sufficient weight to keep the drill from being chuck heavy.—CARL F. BAREIS.



WHEN STEEP TAPERS go beyond the limit of the cross-slide taper attachment, it becomes difficult to get the proper facing. One way of doing it—with a setup for guiding the cross slide—is reported in *Blue Chips,* house organ of Warner & Swasey. This consists of a guide mounted on the hexagon turret and a roller follower on the cross slide. The guide is machined to approximately the angle required on the work. Two screws provide side adjustment in the holder. The roller is mounted on a holding block bolted to the cross slide. In facing the taper, the hexagon turret can be positioned so that when the cross slide is power fed toward the operator, the roller guides against the cam to give the correct taper.

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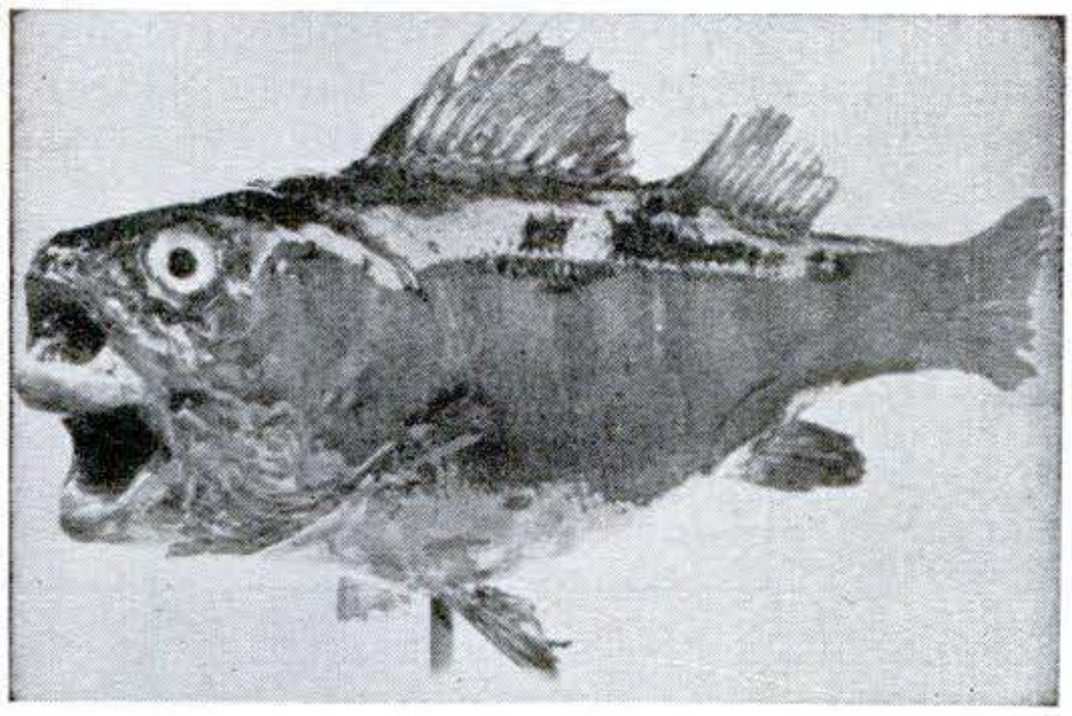
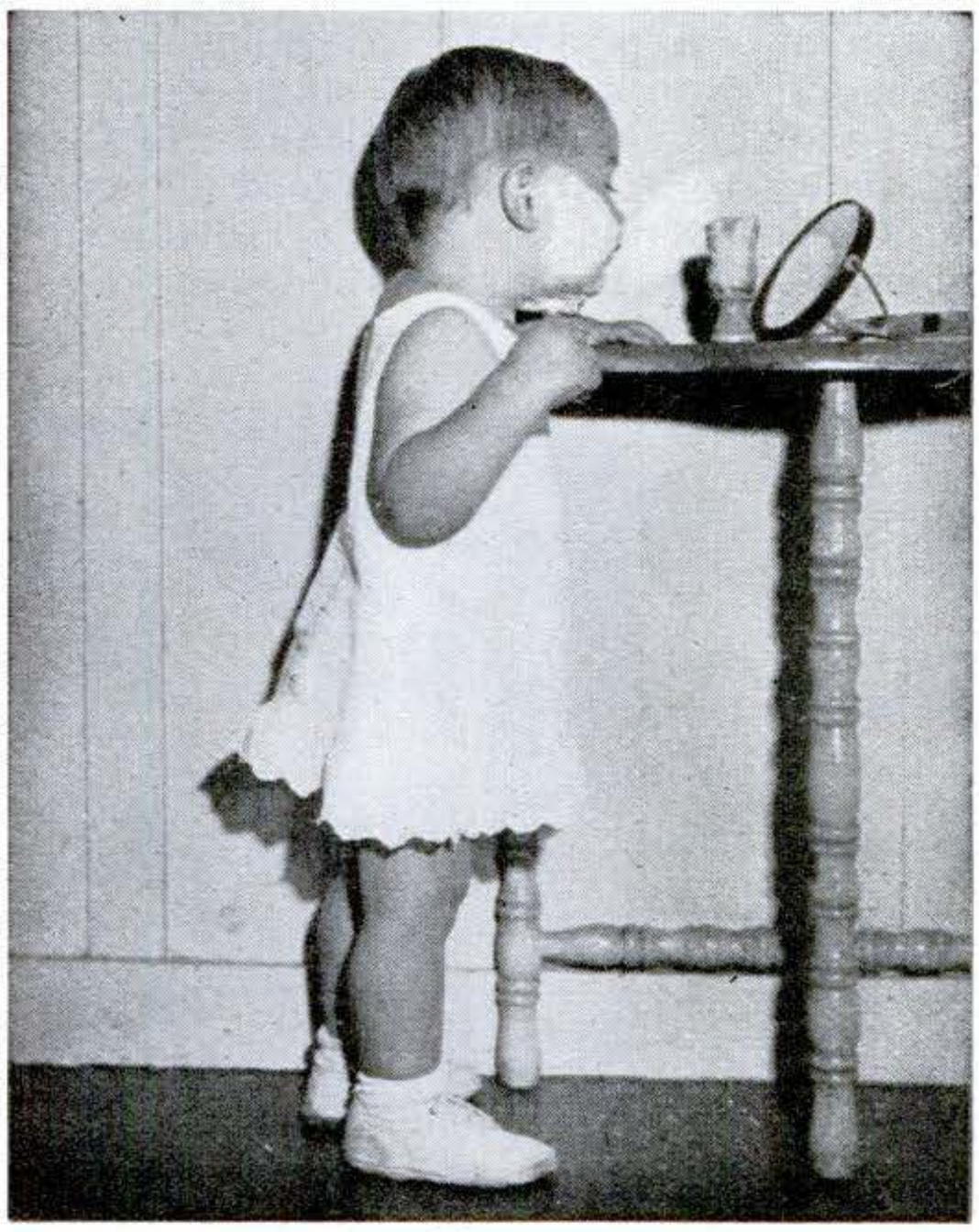
CAN YOU BEAT THESE PICTURES?

We will pay $5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.

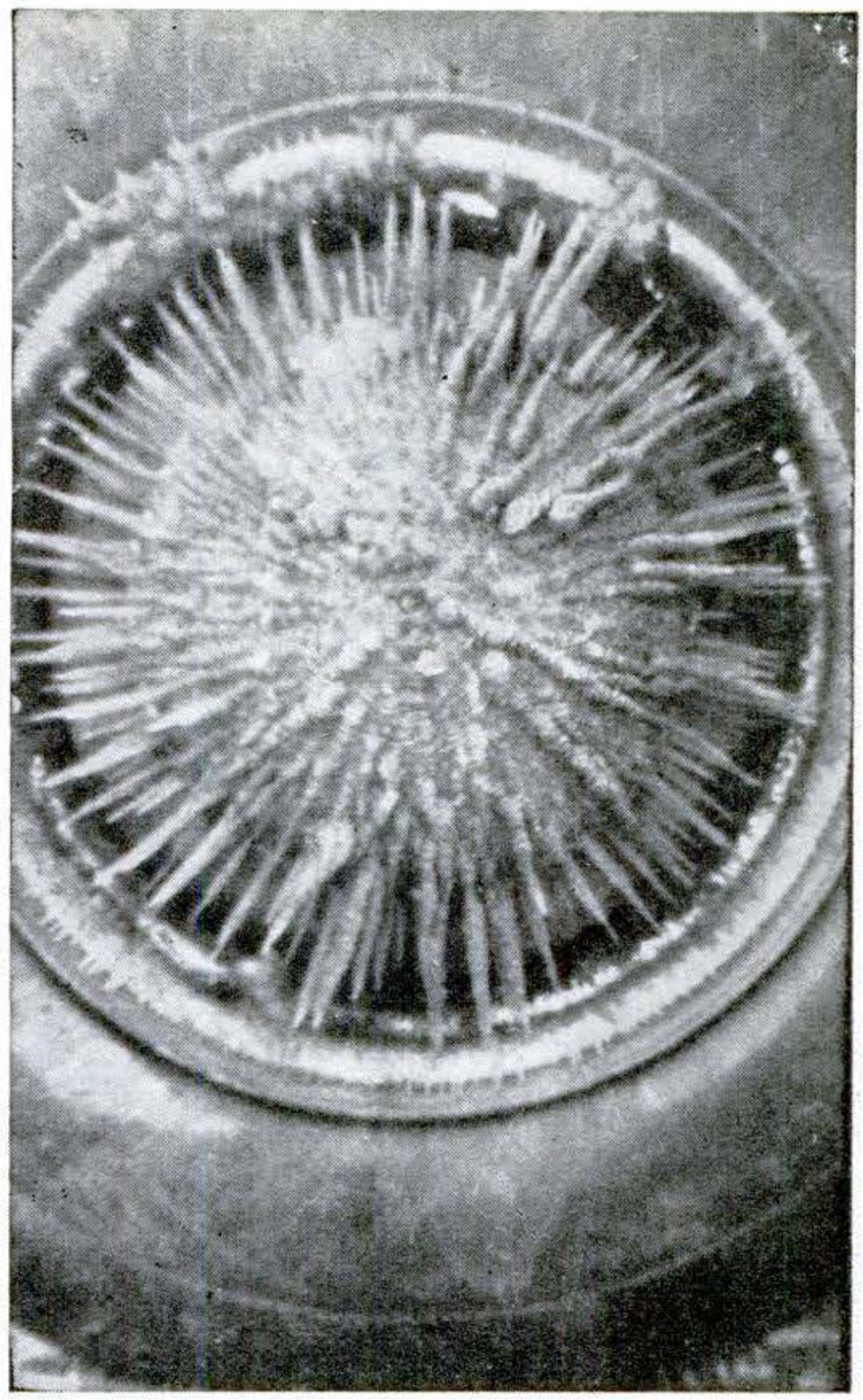


BOTH MOUTHS TOOK THE BAIT when Leo Adams, of Buffalo, N. Y., fished in the Niagara River. At any rate he landed this 6″ perch. It has two distinct mouths.

PHOTO CHARADE. Roger M. Johnston, of Glendale, Calif., sent in the puzzler below. What common expression does it represent? The answer appears upside down below.



"Just a Little Shaver."



PIN CUSHION OR PORCUPINE? Really it's a hub cap. Sleet slanting against the wheel during a long ride through an ice storm was whirled into the odd, stalactited pattern shown in the photo above. The picture was taken by J. L. Cermak, of Weatherford, Okla.

HIBERNATION'S END. Peeping out below are tourist cabins at the 5,000′ level on Mount Rainier in the State of Washington as a winter's snow begins to thaw. Lt. Arthur L. Schoeni, of Arlington, Va., recorded the unusual view with his camera.

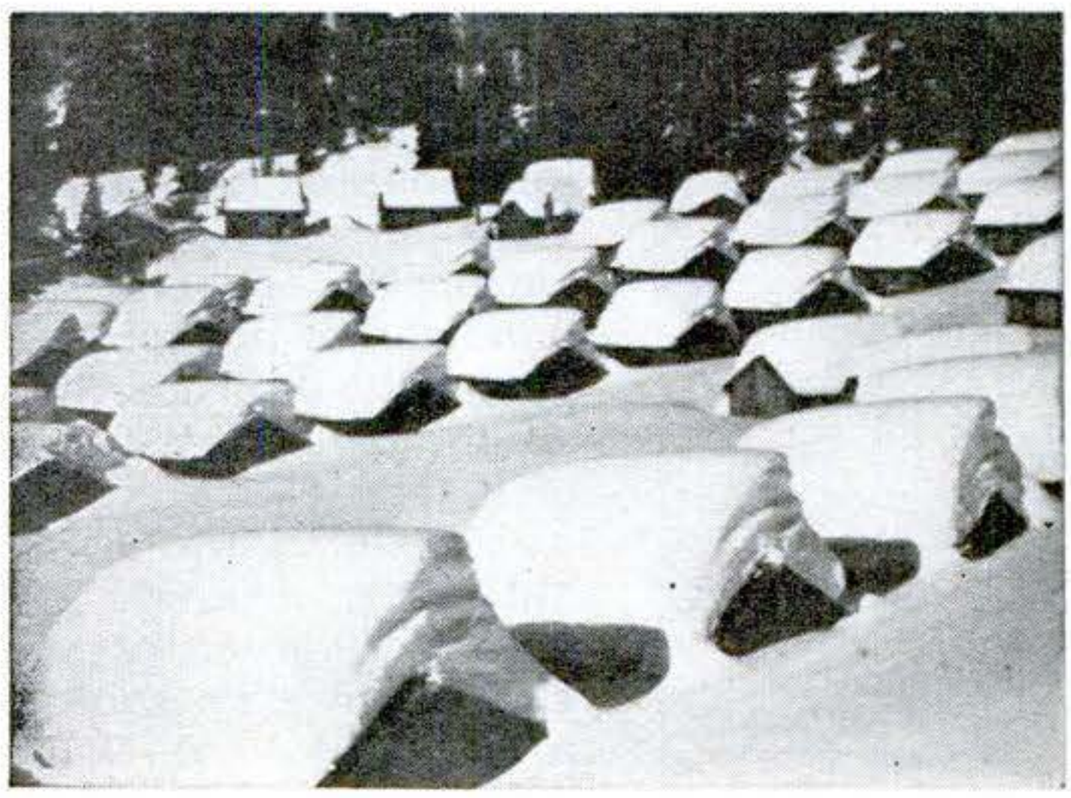


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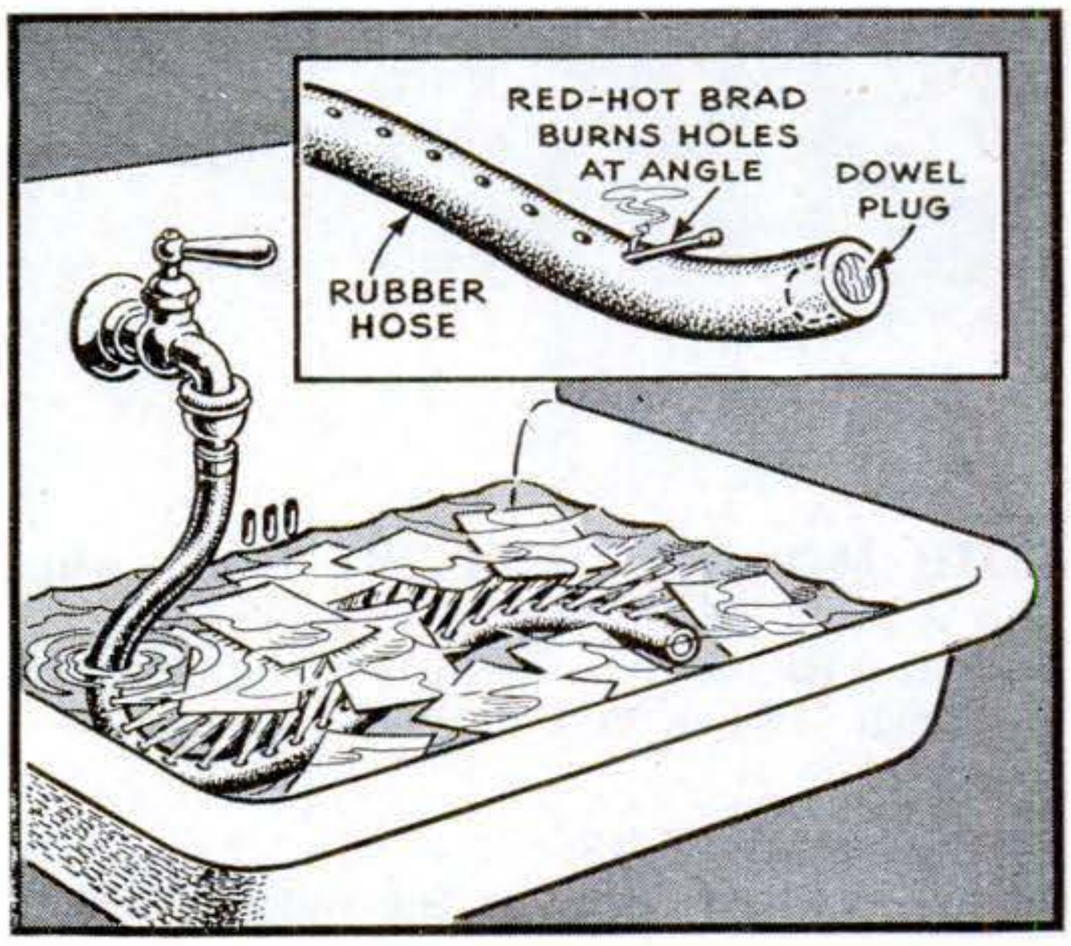
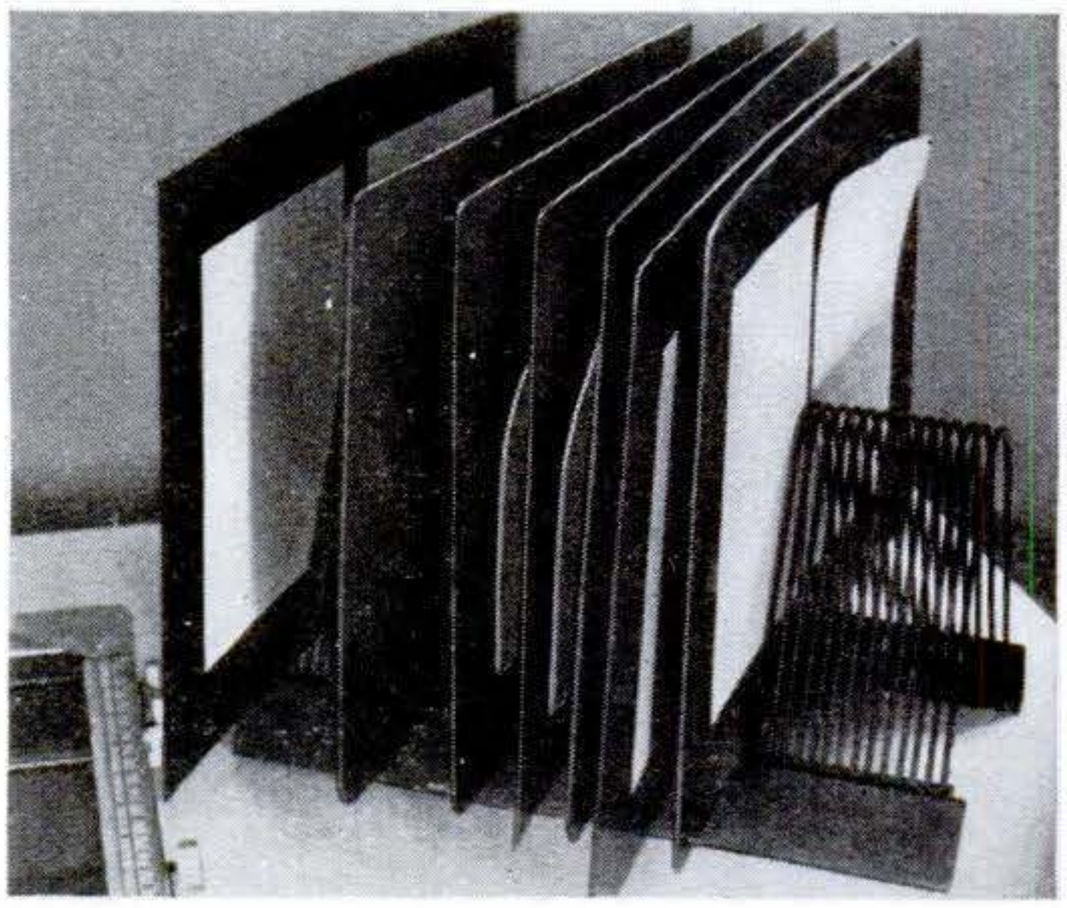
PHOTO IDEAS

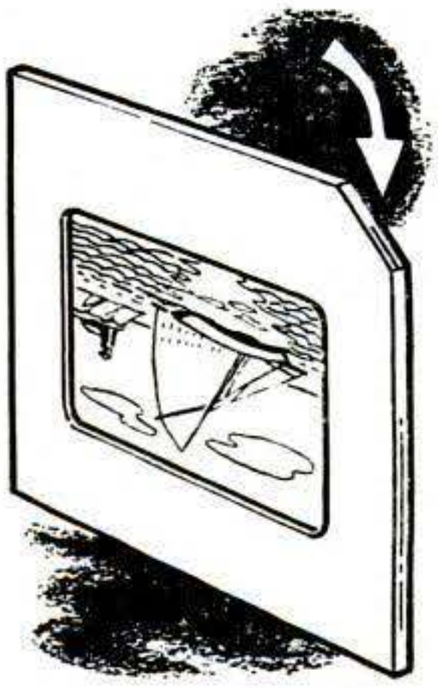
WASHING PRINTS can be expedited by making a series of small holes in a rubber hose, plugging one end with a wooden dowel, attaching the other to the faucet, and curling the hose on the bottom of a tray or tank. Water spurting from the holes will keep the prints in motion and separated. Holes, spaced 1″ apart, can be burned with a red-hot brad or wire. If each is made at a sharp angle, the jets of water will have a swirling action on the prints.—KEN MURRAY.

PROTECTING FINE LENSES from dust and rain when pictures must be taken under adverse conditions is possible with a cap having an insert of optically flat glass, which will cause no image distortion. Optically flat disks are available as war surplus items. A blank reticle 37 mm. in diameter, slightly larger than the lens, was used for the cap above, and a mount and retaining ring were machined from brass. Tiny screws through the mount hold the ring against the glass, and the cap slides snugly over the lens mount. If a lathe is not available, a mount might be made from cardboard, plastic, a small pillbox, or a piece of rubber hose. The disk should be 1/16″ to ¼″ front of the lens to be protected.—*W. E. B.*



FELT-CLAD RACKS for storage of phonograph records provide a convenient way of stacking ferrotype tins. A single rack will hold as many as a dozen tins and still allow adequate space between for good air circulation. If the rack is set on a radiator, hot air rising between the tins will dry the prints quickly.—GEORGE SMITH.





AS A GUIDE for inserting mounted color films right in a projector, I cut off the upper right-hand corner of each one while it is in proper position. Thus, my sense of touch tells me which way a slide goes. If an automatic changer is used, a slide out of position shows up square in the stack.— H. N.

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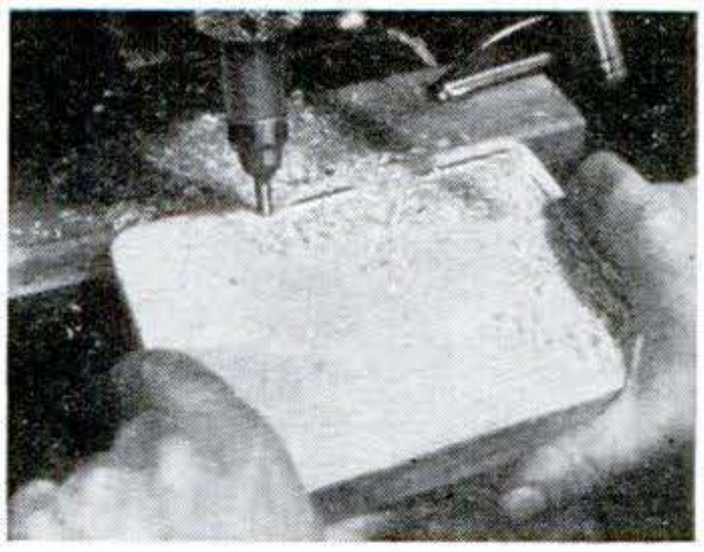
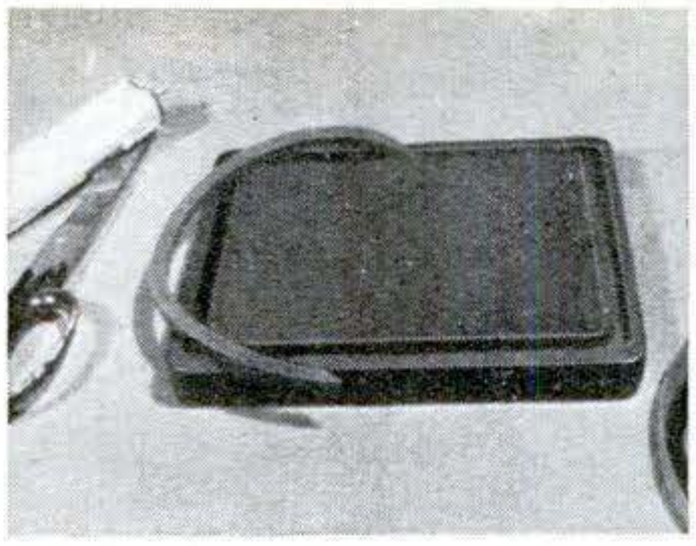
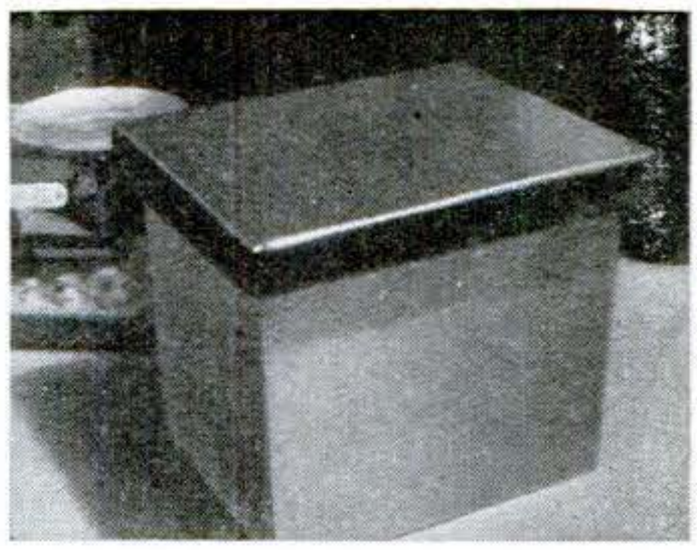


Cut with a router bit or chisel, a deep channel keeps the lid on.



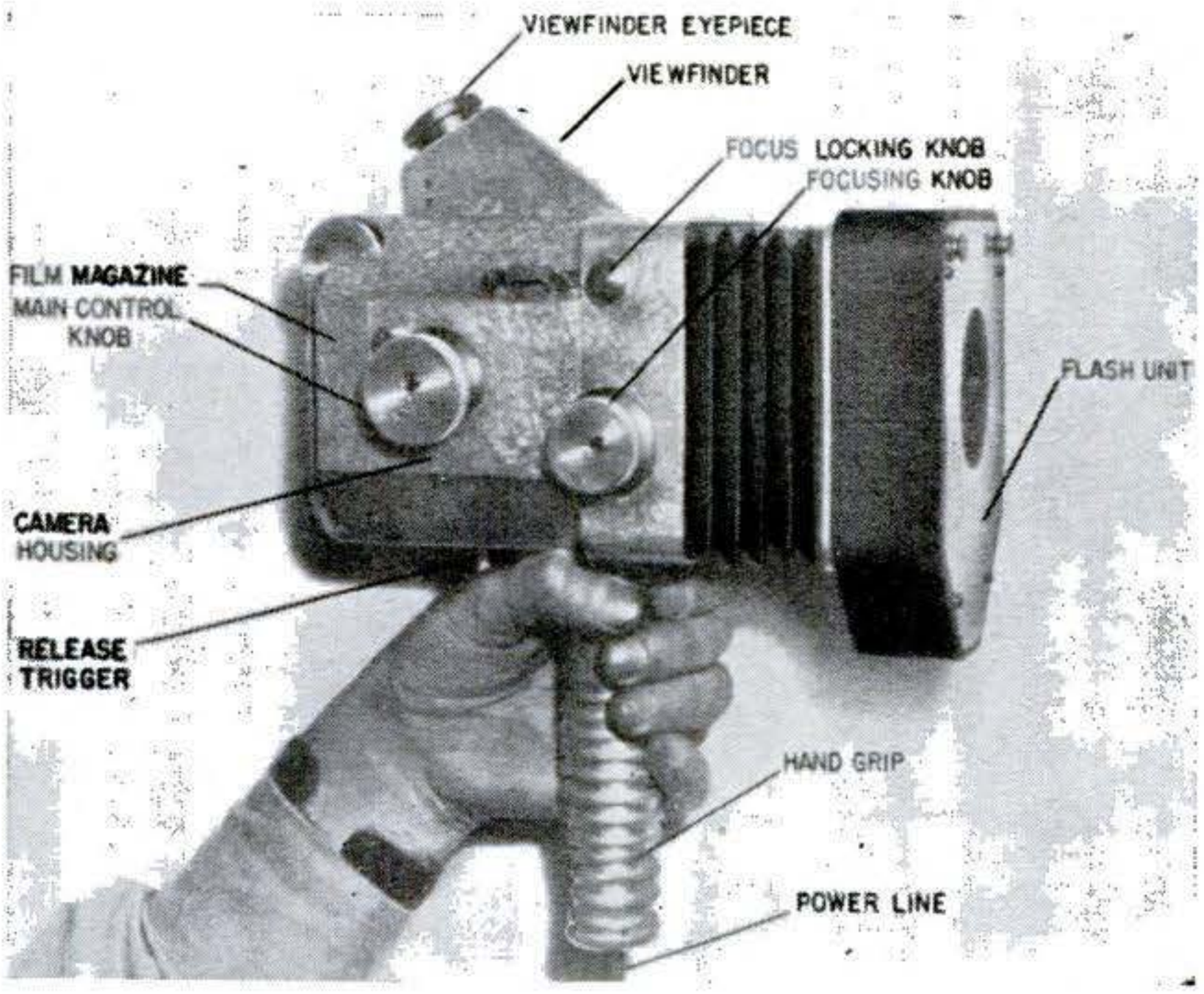
Sponge-rubber tape glued in this groove makes the tank lightproof.

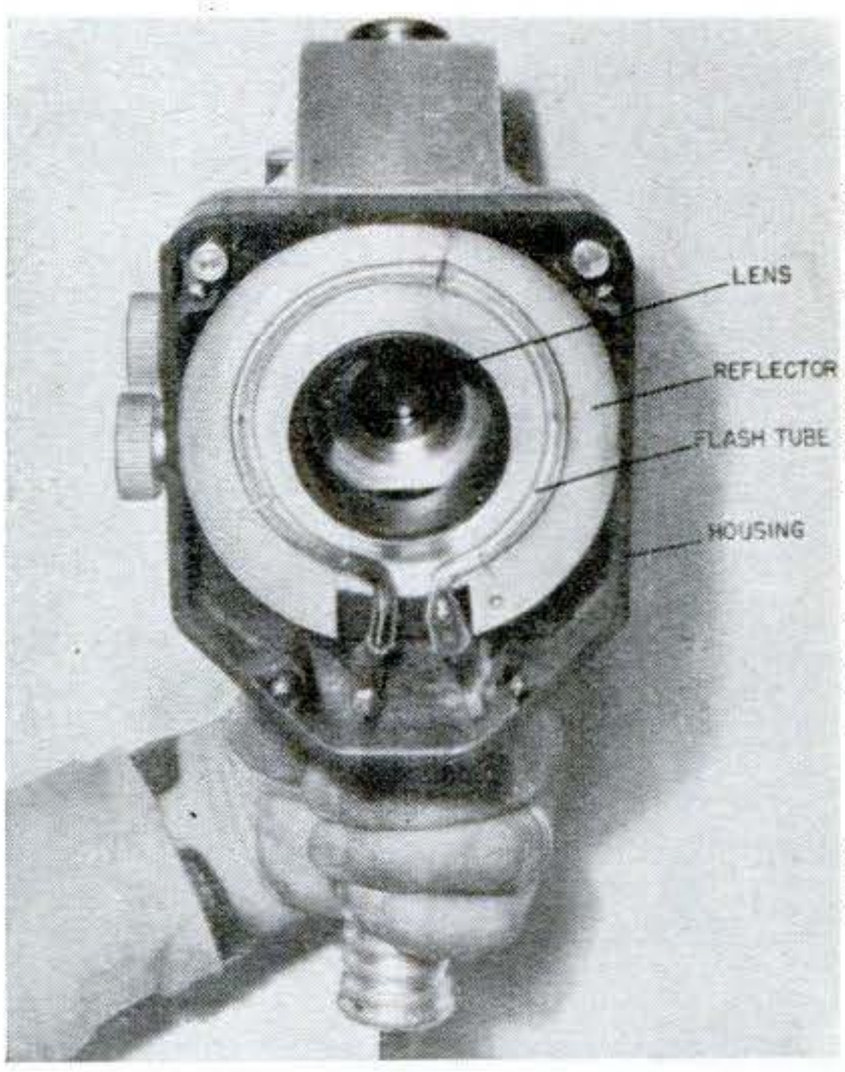


When finished, the lid should be protected with acidproof paint.

A LIGHTTIGHT COVER for a developing tank may be made from ¾″ or 1″ hardwood, cut ⅝″ greater in length and width than the top of the tank. Invert the tank and trace its top on this with a pencil. Then rout a channel ¼″ wide and ½″ deep, keeping the outer edge 1/16″ outside the pencil line to allow a little play. In the bottom of the channel glue a piece of sponge rubber. This can be cut from sponge-rubber tape sold as weatherstripping. Lap the ends at an angle before gluing.—WILL THOMAS.

NEW PHOTO EQUIPMENT





CARRYING ITS OWN LIGHT, a new high-speed camera developed by the Signal Corps is so simple in operation that even an unskilled amateur can obtain good pictures of the fastest action, in color or black and white, either indoors or outdoors, at distances ranging from 6′ to 12′. Except for focusing and clicking the shutter, every phase is automatic. The camera uses 35-mm. film.

Coiled around the lens in a plastic housing is a quartz vapor discharge tube designed by the General Electric Company. This tube gives a flash more intense than sunlight and lasting only 1/25,000 of a second, a speed which easily "freezes" whirling fan blades. The camera, which weighs 5½ lb., is operated from a portable electric power pack which may be plugged into any ordinary current line. The pack weighs 47 lb.

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HOW SMALL

By Elon Jessup

UNLESS you are a frostbite dinghy skipper and don't mind risking an ice tussle for the sake of the sport, the best way to handle ice with a small craft is to leave it strictly alone. Thinly planked small boats were never built to compete with icebreakers, and there are few worse punishments that a boat can take.

But if you must bring your cabin cruiser up from Florida before the season ends, or chance catches your boat in the water during the winter freeze, there are ice-breaking methods that are useful to know. Eskimo seal hunters have proved that even their little skin-covered kayaks can be worked through ice when properly managed. Adequate handling may save your boat from destruction, and possibly save you from a very cold wetting.

In any event, don't just slam ahead regardless. The heavy boat in the photo at left shows how difficult this tactic is. Strongly built, of deep forefoot, and apparently

Ramming thick ice is rarely effective. Even a heavy boat like that at left often makes little progress that way. A better method, if forward draft is shallow enough, is to lighten the bow, give the boat the gun, and slide up on the ice. Even a small boat can break through this way.

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BOATS CAN BATTLE ICE

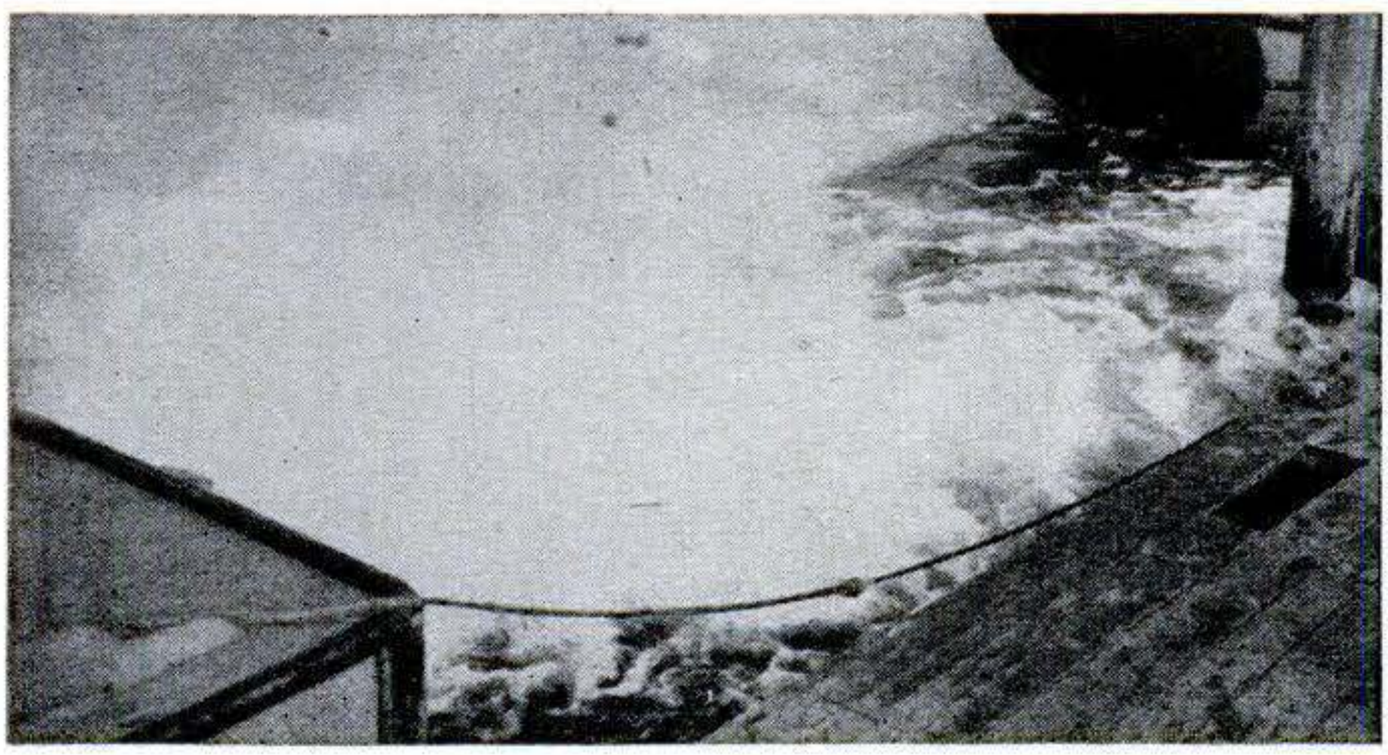
capable of crashing through anything, it has tried to muscle through an ice field by straight-ahead ramming — and has made only a dent. Old-time icebreakers, built for this work, could ram with some success, but even these are gradually giving way to a new type of boat with a turned-up bow that slides up on the ice like a sled and crashes through from sheer weight. If your boat has a shallow forward draft—and most small boats have—this trick may help.

Another modern development in ice breaking, sometimes known as the artificial-river method, consists of creating a turmoil in the water directly under the ice and for a short distance ahead. Some icebreakers are equipped with a special propeller under the bow that they use for this purpose. Obviously, the average small pleasure boat is designed neither for installation nor handling of a bow propeller, but making use of the propeller to cause turbulence under the ice can be very effective. The owner of the heavy boat that didn't go far with ramming might have made better progress with backing and underwater turbulence. Fouling of the propeller is the thing to watch out for.

Side-to-side roll will also break up ice and is sometimes practiced by professional icebreakers. When ice is very thin, it can be cracked up with an oar. But even thin, windowpane ice can cut into boat planking like a sharp knife. That's why many winter boatmen attach protective sheathing outside the hull. It usually runs from the stem to about amidships and extends from below the water to a few inches above the waterline. This hardwood planking is usually the most satisfactory, but copper sheeting is also used. Planking can be nailed or bolted on and removed in the spring. Nails should be driven with due regard for the thickness of the hull.

Boats that must be left out in winter although not used should also be guarded against crushing by ice. Buffers such as old tires, logs, and timber around the water line will do. If the boat is frozen in near a float or dock, break or saw out a narrow channel along one side to relieve pressure.

Cakes of broken-up ice are cleared away with a boat hook. If the boat is headed to one side and then the other in sliding onto ice, it opens a wider path. Below, a small boat creates an "artificial river" by churning with its propeller. But the boat must be tied up so it will remain stationary. At right, it widens the channel with its prow snubbed against the float.



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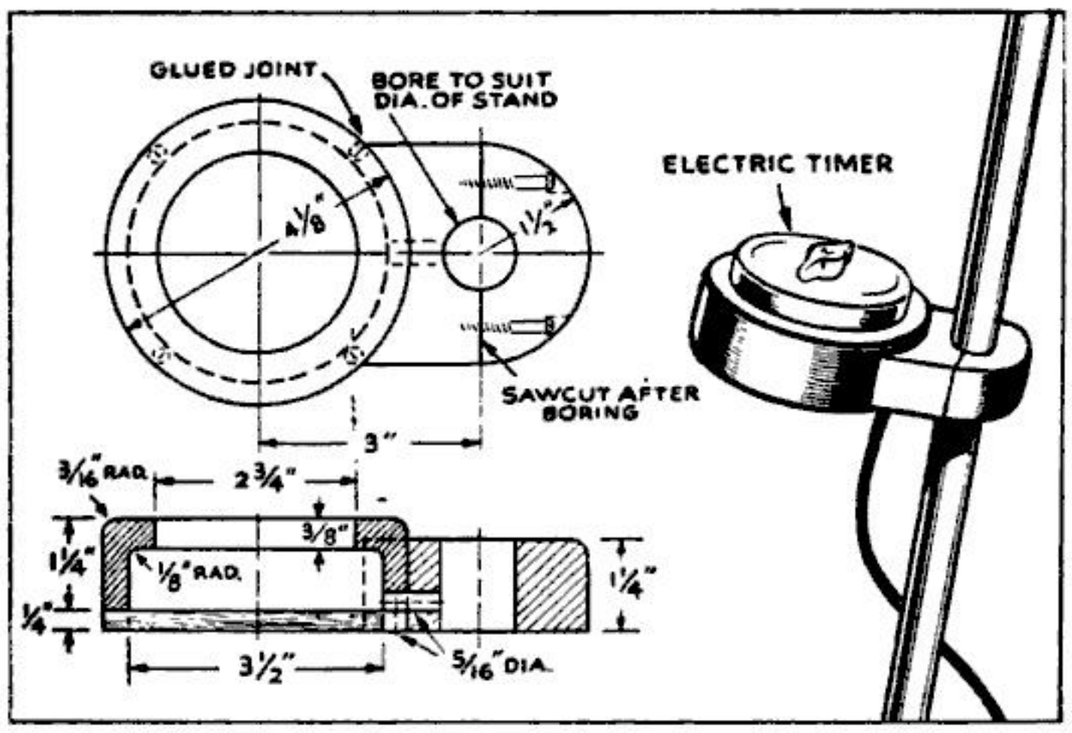
Once a free channel has been made in the ice, it can be kept free by running the boat through every once in a while. Thin windowpane ice looks harmless, but it is very sharp and will cut planking badly. It can be broken up easily, though, by reaching out with an oar, as at right, or simply by rocking the boat.

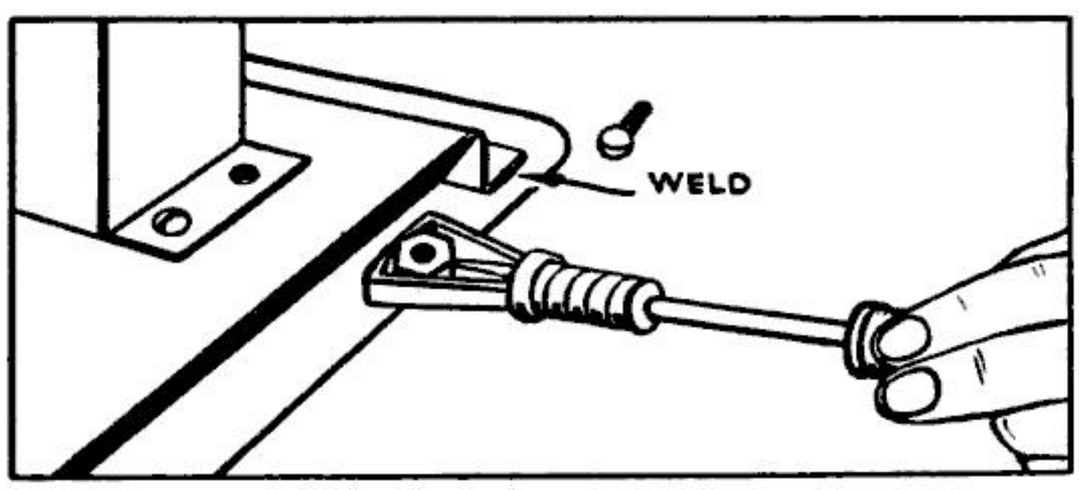
If a pair teams up and one is good at sculling, the ice-breaking problem can be handled as at left with the man forward reaching out and breaking the ice ahead with a boat hook or oar. A boat should never be allowed to remain solidly frozen. When ice isn't too thick, cut it with a boat hook to relieve pressure.

For really thick ice, it is best to get an ice saw. A narrow channel cut alongside the water line, as at left, provides room for ice expansion. Sheathing of old lumber, preferably oak, will protect a boat at and beneath the waterline when it crashes into ice. Bolt or nail it on from stem to amidships, as below.

Holder Keeps Timer on Sunlamp

BECAUSE they were sold without holding devices, thousands of sunlamp timers suffer from a generally untidy appearance and a constant danger of falling. The holder shown below overcomes both hazards. It is made in three pieces of any hardwood. The dimensions given will fit most timers but may have to be altered for some.—A. C. WATSON.

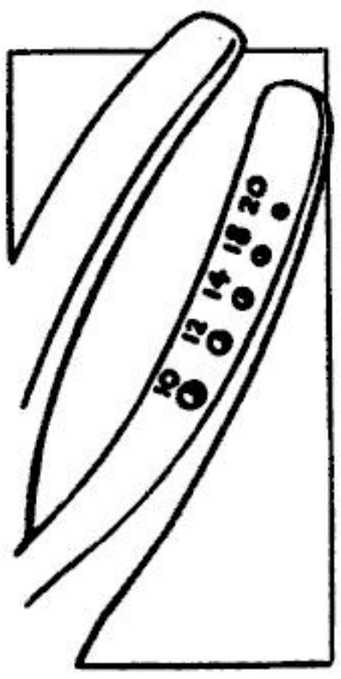




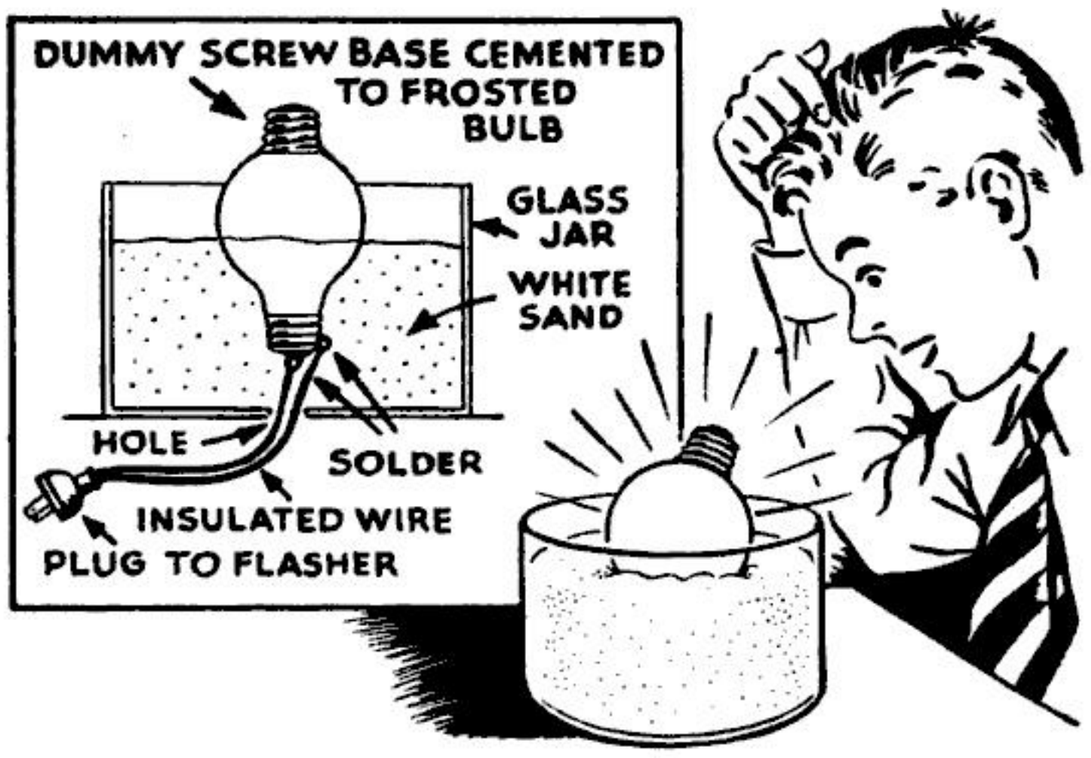
Screwdriver Gets into Corners

WORKING in tight spots on radios, cars, and similar compact assemblies, I have found that a screw-holding screwdriver, used as shown above, is often helpful for holding nuts in places that fingers can't reach. Adjust the spring-metal gripper to hold the nut firmly between the jaws and the screwdriver point.—J. P. LEGER.

Plier Handles Show Wire Sizes



WIRE gauges are easily misplaced, but pliers have to be kept handy on any wiring job. One electrician solved his gauging problem by drilling five holes in the handle of his pliers. Diameters correspond to those of the more common wires; identifying numbers are etched with an electric pencil or scratched with a scriber.—RONALD EYRICH.

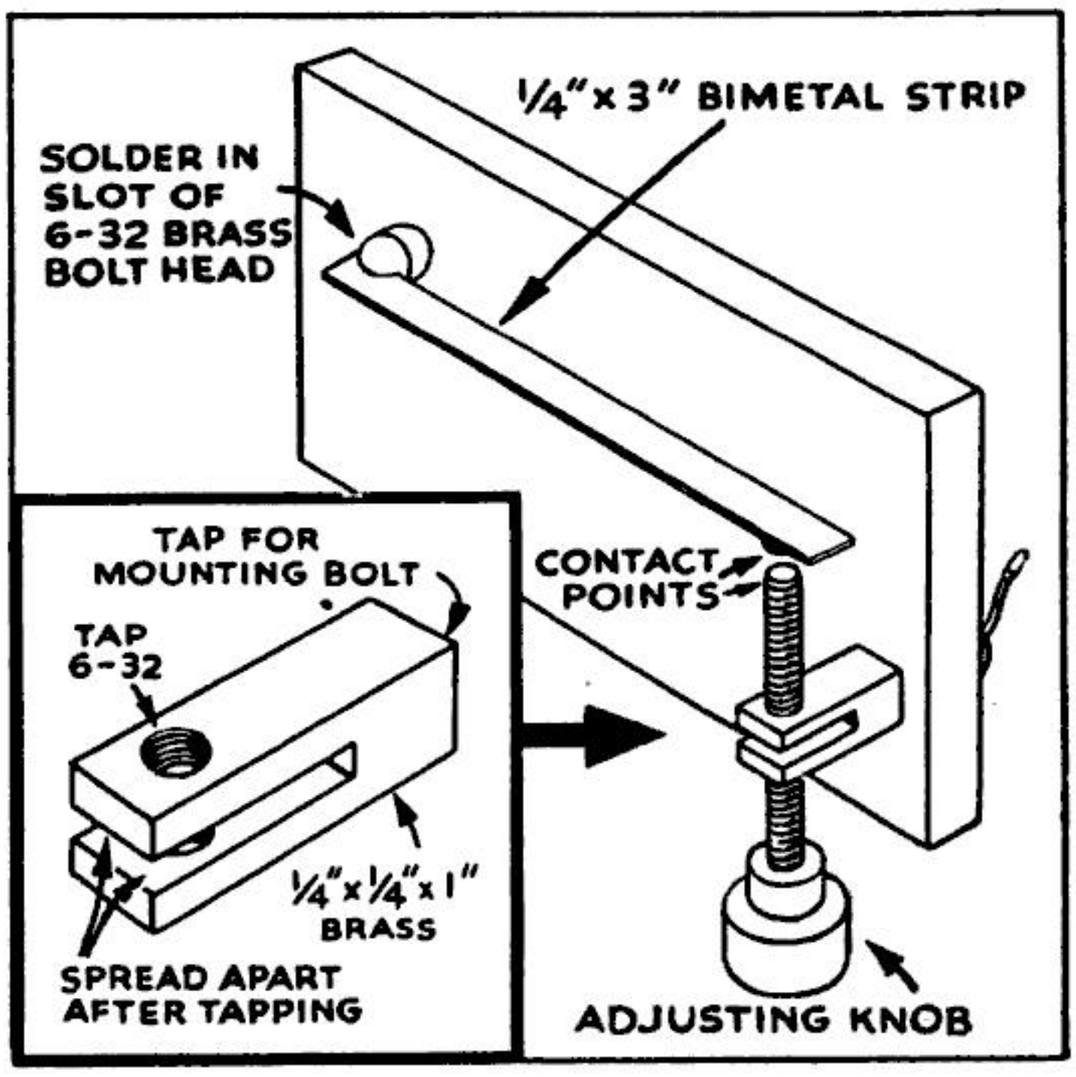


Bulb Lights with Base Exposed

THIS electrical display is bound to draw attention, not because of the amount of light it casts, but because the upended base seems to prove that it's done without wires. Remove a screw base from a burned-out lamp by heating gently over a gas flame while pulling the metal with pliers. A broken triangular file and turpentine are used to drill the glass jar.—GEORGE BARR.

Slotted Post Holds Adjustment

CRITICISM of homemade or simple commercial thermostats often centers around the fact that is difficult to lock a setting without upsetting the adjustment. A small brass post, slotted as shown in the drawing below, can be made to lock the adjusting screw exactly where you want it. Tap the post, slot it with a hacksaw blade, and spread the prongs thus formed slightly apart. To insert the screw, squeeze the prongs together with a pair of pliers.—H. W. HOLT.



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CURRENT QUIZ

Ten Questions Test Your Electrical Wits

KNOW your coulombs and farads? Brush up on your electrical memory and plug away on these high-voltage teasers. Don't be shocked if you miss some. With 10 right you're 100 percent on the beam, 90 percent is still in phase, and 80 percent is a good power factor. A rating of 70 shows a memory arc; less than that, a dead short. The questions are given below, and the answers are under them, upside down.

1. Two bulbs in series draw approximately how much current compared to the amount they would draw in parallel? (a) Twice, (b) half, (c) one fourth.

2. If the secondary of a transformer is short-circuited, the primary (a) draws no current, (b) is also short-circuited, (c) draws excessive current.

3. Instead of using a single dry cell, you connect two in the same circuit with plus terminal to plus and negative to negative. They will (a) last longer, (b) discharge each other, (c) afford 3 volts instead of 1.5.

4. Shading coils are found in (a) fluorescent-lighting circuits, (b) induction motors, (c) transformers, (d) electric chairs.

5. Static electricity is so called because it (a) consists of electrical charges at rest, (b) causes static on radios, (c) is produced by stationary waves, (d) is induced in A.C. motor stators.

6. A welding transformer designed for 60-cycle A.C. is to be rebuilt for use at the same voltage on 25 cycles. It will need (a) a larger iron core, (b) more wire in the secondary, (c) a center tap in its primary.

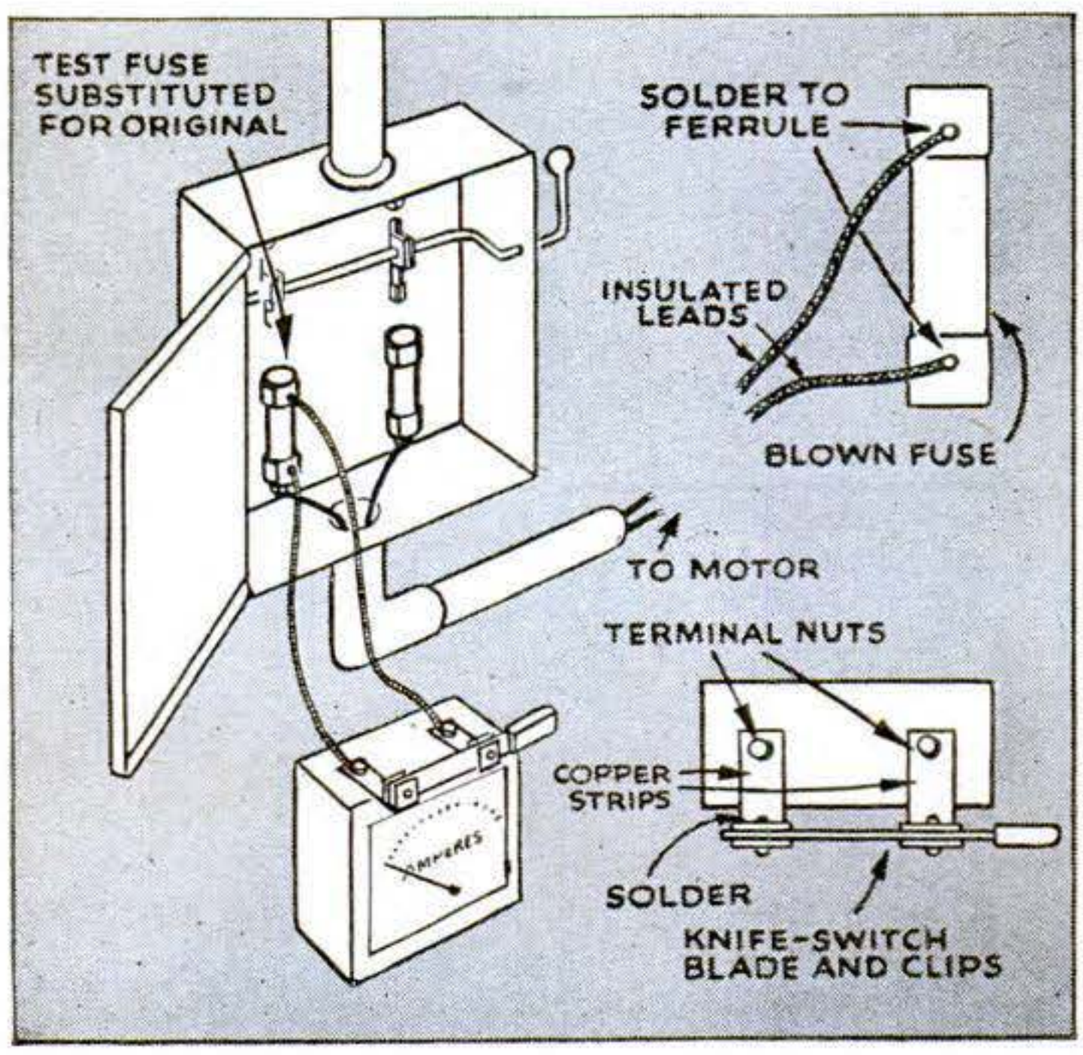
7. If the two coils of a transformer in operation were free to move with relation to each other, they would (a) draw together, (b) repel each other, (c) spin in opposite directions, (d) remain completely motionless.

8. In a three-wire 115-230 volt system, the middle (white) wire is at what potential to ground? (a) Zero, (b) 115 volts, (c) 230 volts, (d) 460 volts.

9. The condenser or capacitor in a capacitor-start split-phase motor (a) stores electricity for use if power fails, (b) provides a phase difference for starting (c) is necessary for reversing rotation.

10. Maximum (peak) voltage of ordinary 115-volt A.C. is (a) 162, (b) 141, (c) 115.

ANSWERS: 1 (c), 2 (c), 3 (a), 4 (b), 5 (a), 6 (a), 7 (b), 8 (a), 9 (b), 10 (a).



Blown Cartridge Fuse Provides Line Connection for Ammeter

IN COMMERCIAL shops where ampere readings are required to test motor loads and the like, a blown cartridge fuse will permit cutting in an ammeter in series without opening joints or separating connections. Flexible leads are soldered to the fuse ferrules, and the fuse is substituted for one of the good ones in the fuse box, as shown in the drawing. The leads are then connected to the ammeter terminals, on which a knife switch is provided for shunting out the instrument while the motor is being started.

Two fuses, one O-30 amp. and the other 31-60 amp., will cover most of the shop-motor range.—HAROLD P. STRAND.

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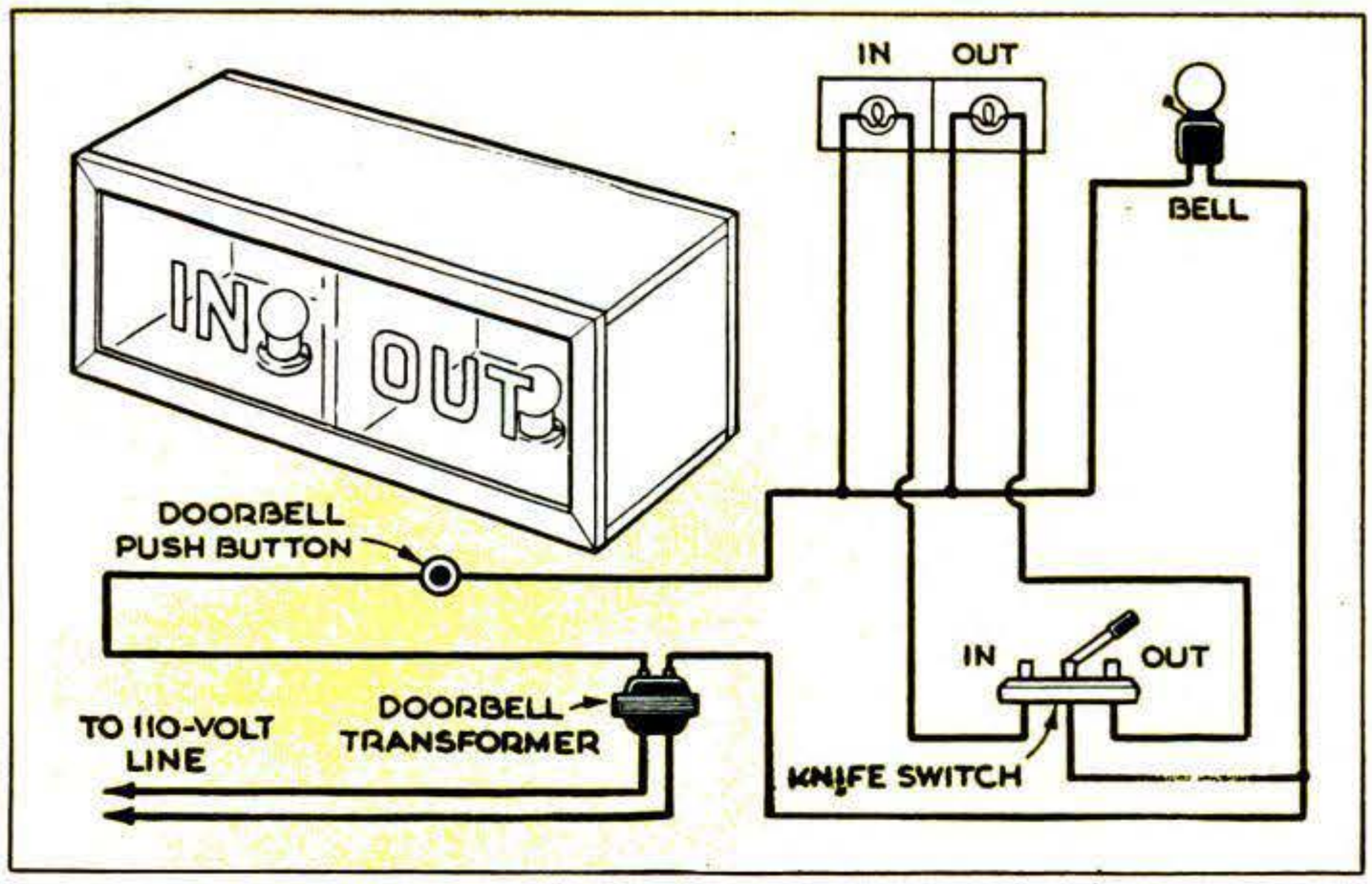
Ringing lights half the box, which stays lighted as long as **the button is held.**

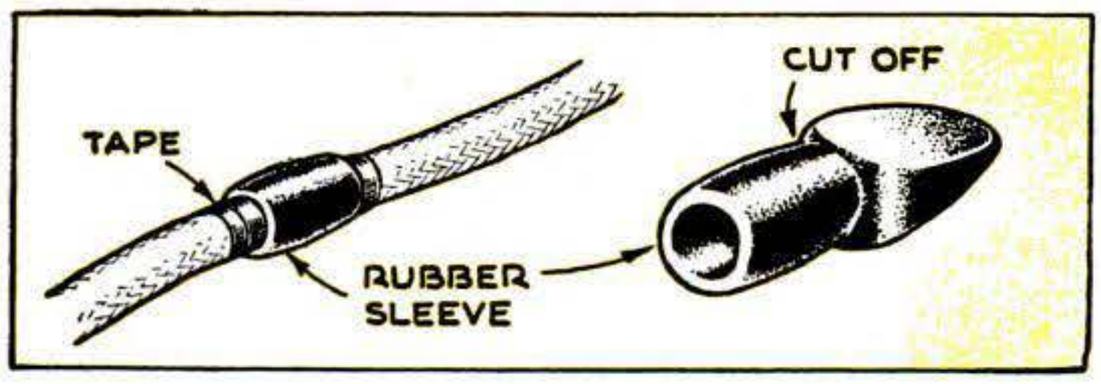


Signal in Doorbell Circuit Tells Caller You're In or Out

IF YOU worry about visitors leaving before you can answer the door, you still need not drop work and run every time the doorbell rings. A signal light built into a small box and connected in the bell circuit will notify them to wait when you are in or announce the fact that you have gone out. All you need do is to throw a switch indoors beforehand.

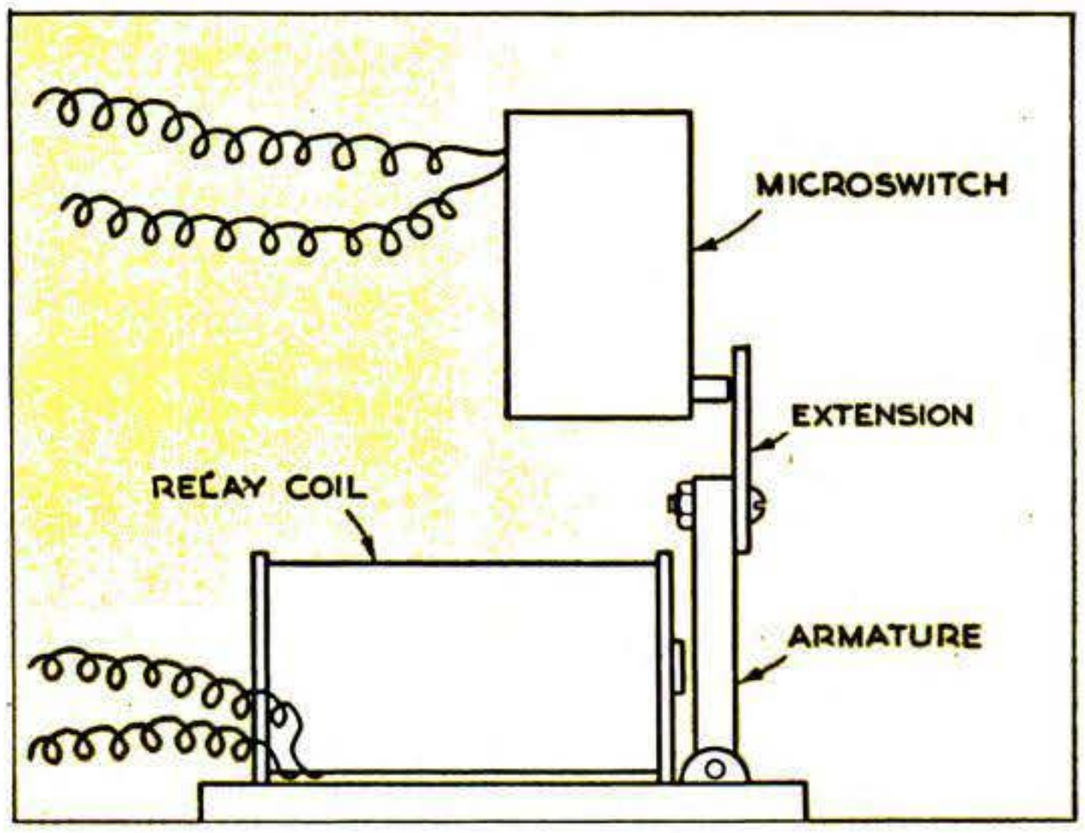
Build a simple box of light wood, put a solid partition in the center, install appropriate lamp sockets, and cover the front with glass on which the words "IN" and "OUT" have been lettered. Any 6-volt lamp, such as an automobile taillight, will work in a bell-transformer line, while a flashlight lamp will serve in a battery circuit.

A wiring diagram is shown above. Be sure to connect the transformer or battery side of the line to the knife blade of the switch. The other two switch contacts should be marked.—BARNEY M. JENSEN.



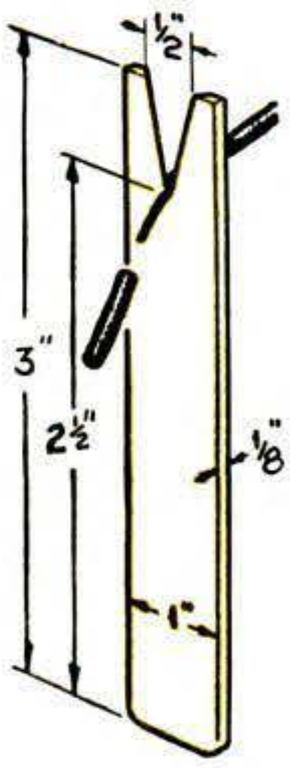
Eraser Protects Wire Splice

SLEEVES cut from pencil erasers of the type shown above will protect insulation tape over a spliced wire. Use one or more sleeves, working them onto one side of the wire before making the splice, and then work them over the tape.—H. KLEIN.



Pocket Wire Stripper Fits on Key Ring

FOR an efficient wire stripper, hacksaw a notch in a piece of ⅛" steel of the dimensions shown at right and file a bevel on one side. To strip stranded wire, drill a hole the wire size and cut the notch to it. A hole at the other end will permit attachment on the key ring. —DAVID B. CLAPP.



Plunger-Type Switch Increases Capacity of Small Relay

THE current-handling capacity of a relay can be considerably increased by the method shown above. A short extension on the relay armature activates a standard plunger-type snap switch or microswitch. These switches are available in ratings up to 15 amp. at 115 volts. Single or double-pole, normally on or normally off types can be obtained. The plunger requires only slight pressure and has a travel of about 1/16".— W. R.

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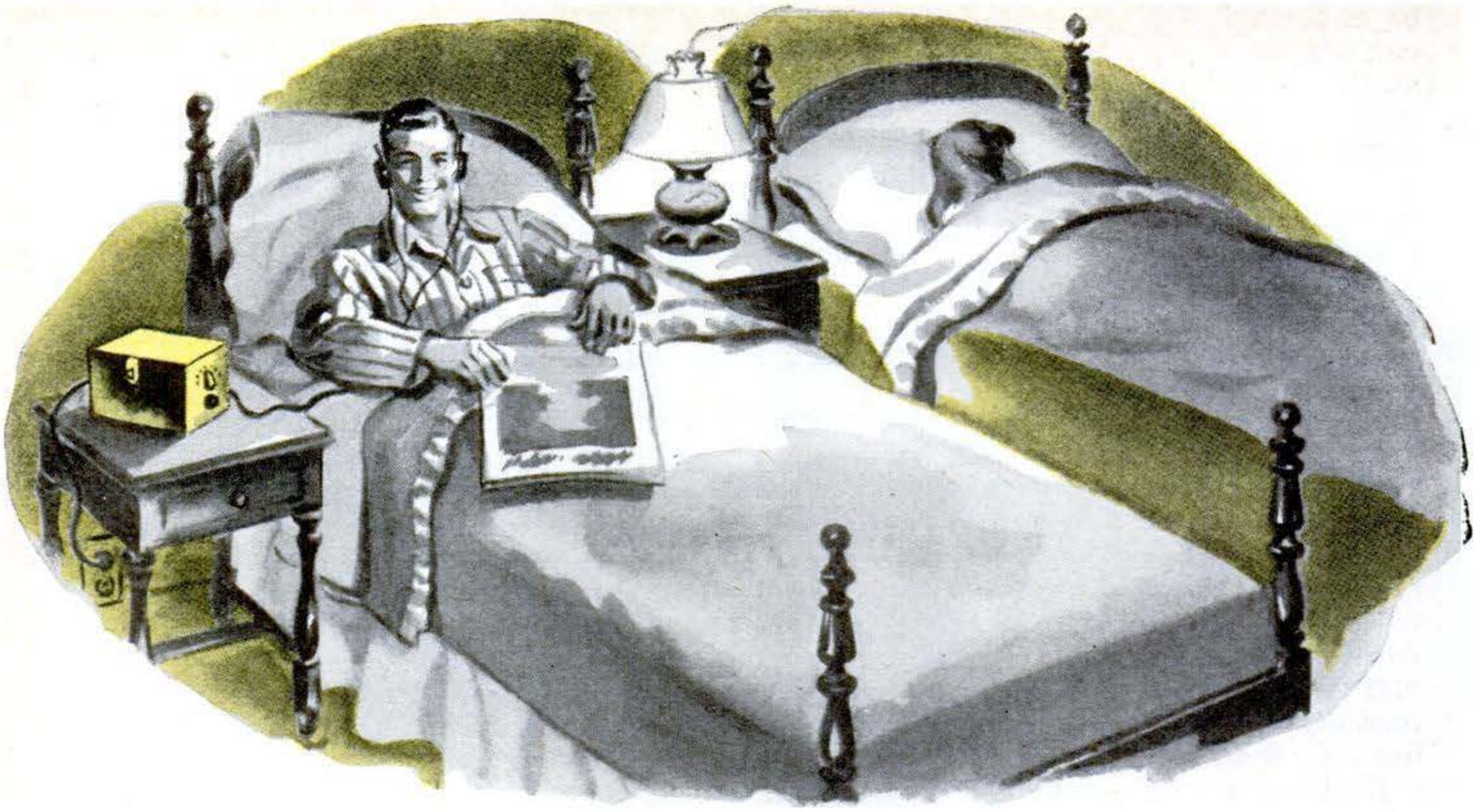


PERSONAL RADIO

WITH A BEDSIDE MANNER

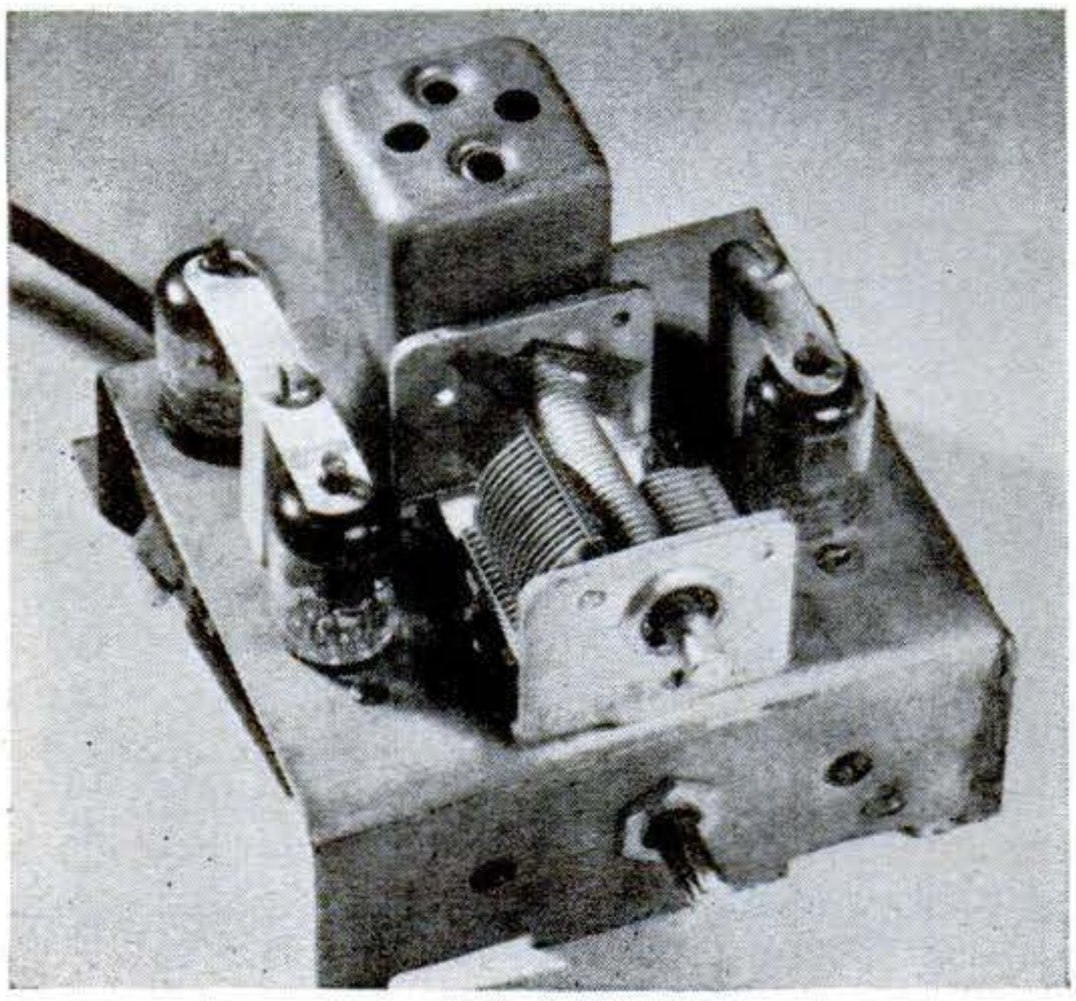
By Albert W. Hellenthal

INSTEAD of thinking harsh thoughts about members of your family who frown on your radio listening when they want to read or sleep, try one of these compact personal radios that make the entertainment of the airwaves your private business.

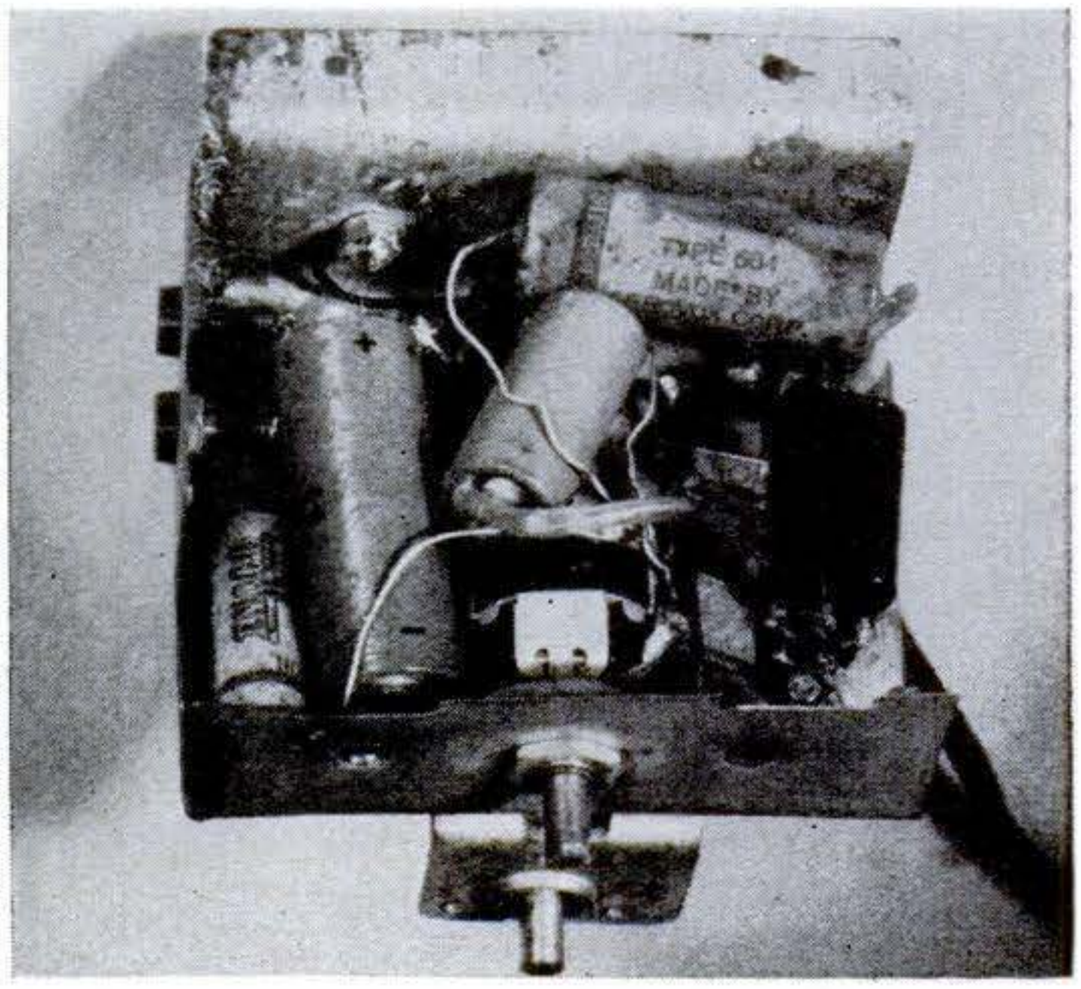
This set can practically be built out of the spare-parts box, for with the exception of the resistance in series with the heaters, none of the specified values is critical. In selecting both condensers and resistors, a tolerance of about 20 percent is permissible. The set can be used on A.C. or D.C.

Lay out your parts before cutting the chassis. The one shown here measures 1½" by 3½" by 4", but some variation may

Since the wires are stored inside the cabinet, exposed parts are carefully shielded and secured.



Compactness is achieved through design rather than through the use of small parts. Note the odd sizes.



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be necessary, depending on the parts you can obtain. One 9002 tube is used as an A.F. amplifier; another, with its plate and grid tied together, serves as a diode half-wave rectifier for the power supply. The third tube, a 9003, acts as detector and R.F. amplifier. Regenerative oscillation, used to get added selectivity and gain, is controlled by putting the volume control (R2) in the screen-grid circuit.

With all tube heaters connected in series, a 600-ohm voltage-dropping resistor must be inserted in the line. Any combination of line cords adding up to 600 ohms will serve.

One of the last steps in the wiring consists of winding the feedback, or tickler winding. This goes next to the grid section of a standard iron-core adjustable antenna coil. Two to 10 turns of 30-gauge enameled or D.S.C. wire will be needed. Turn the set on and find the exact number of turns by experimenting. If no effect is noticed while making the adjustment, try reversing the leads.

Hard composition-board sides and an aluminum front were used for the cabinet shown, which measures 4½" by 4¾" by 6¼". To prevent the tubes from working loose in their sockets, two 1¼" wood posts were fastened to the chassis. Small metal crossarms have holes drilled to fit over the glass tips.

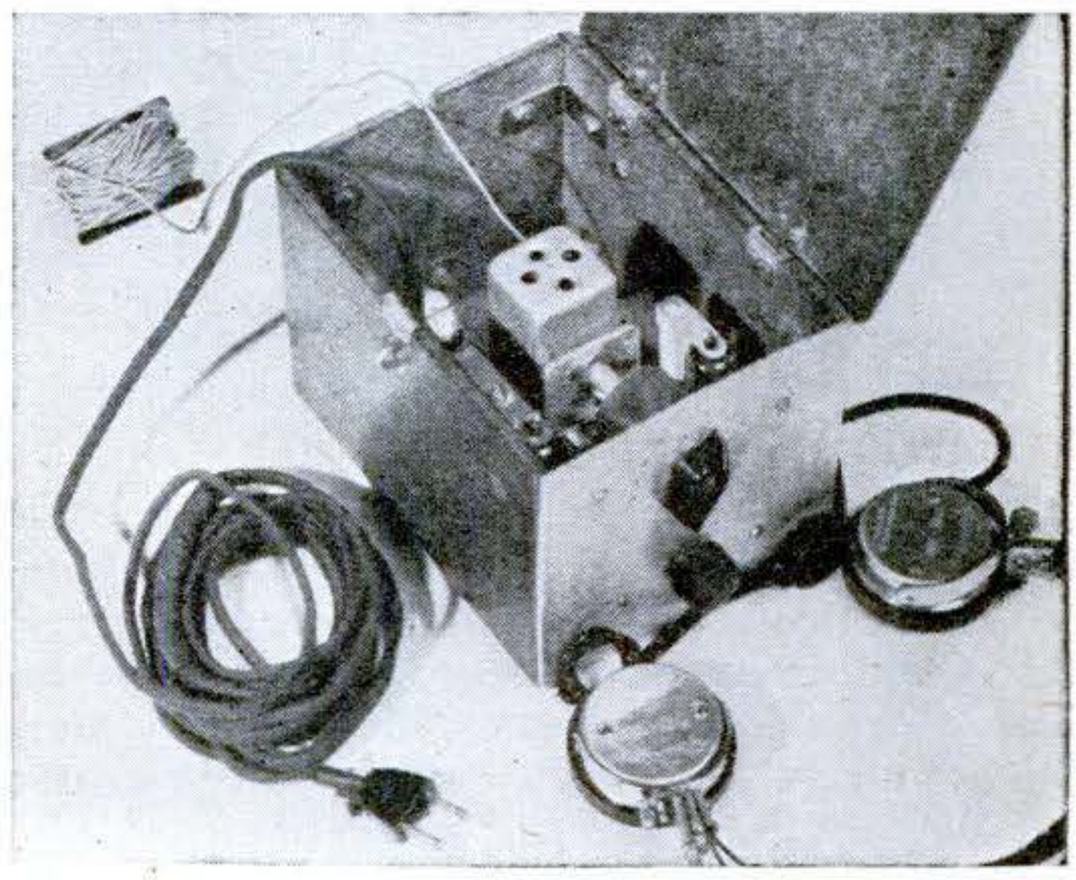
A 25′ length of covered-wire antenna, dropped out the window or fastened to a bedspring, will bring in the local stations. As the power line goes to chassis, use no ground and keep the set away from radiators.

Although this set is designed for personal listening, it has enough power to drive a small speaker. Should you want to add one to yours, follow the inset shown in the diagram below. The extra parts that are needed are marked "optional."

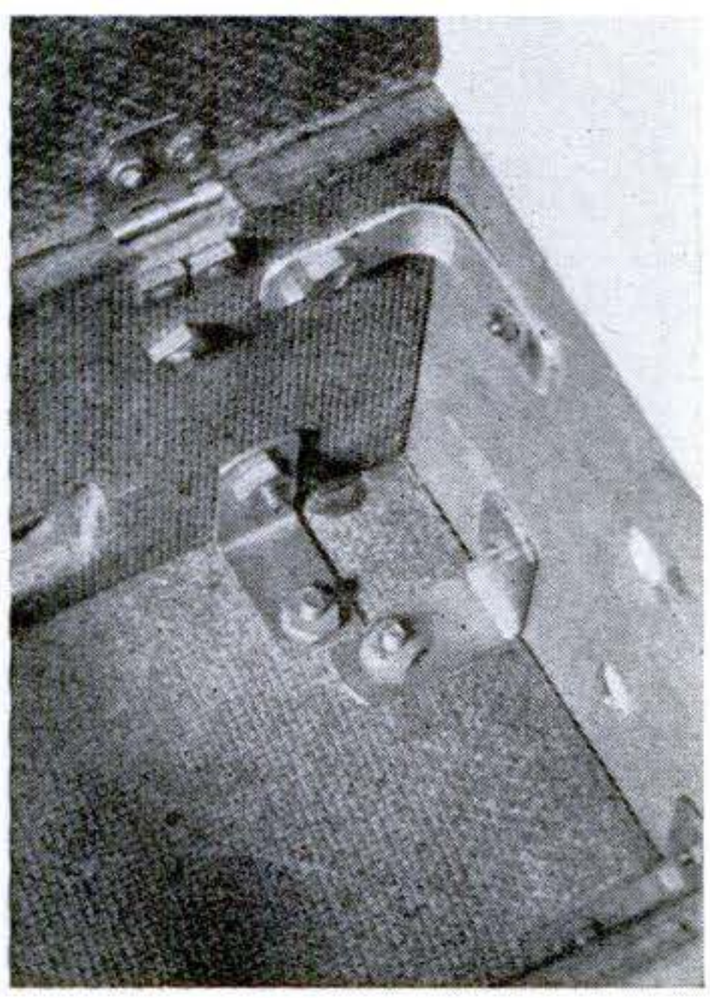
List of Parts

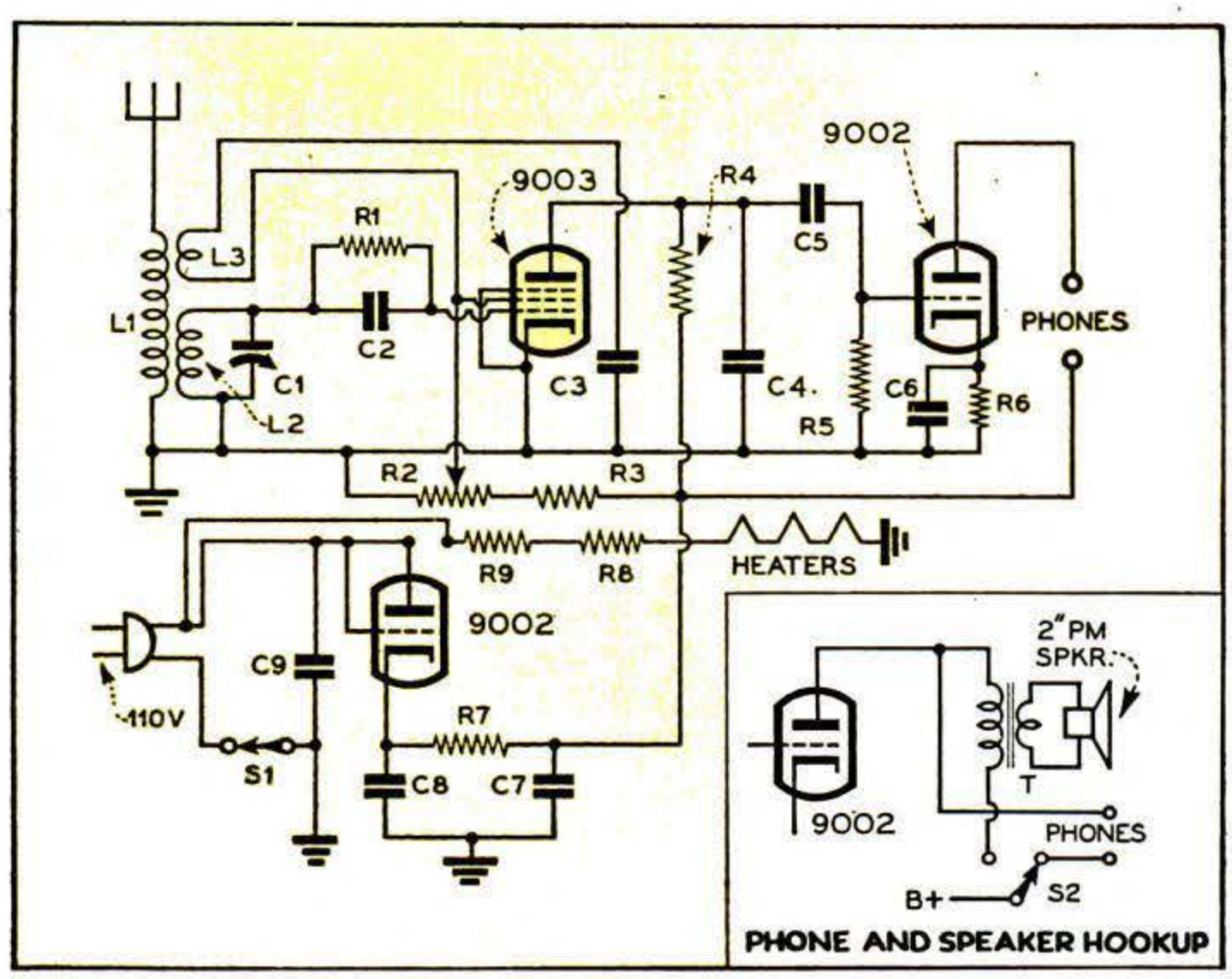
L1, L2: Standard adjustable iron-core antenna coil.
L3: Tickler coil.
C1: 365-mmfd. midget tuning condenser.
C2: .00025 mfd., mica.
C3, C6: .5 mfd.
C4: .0005 mfd., mica.
C5: .03 mfd.
C7, C8: 20-20 mfd., 150 volts, electrolytic.
C9: .05 mfd., 400 volts.
R1: 2 meg., ½ watt.
R2: 15,000-ohm potentiometer.
R3: 50,000 ohms, ½ watt.
R4: 45,000 ohms, ½ watt.
R5: 100,000 ohms, ½ watt.
R6: 800 ohms, 1 watt.
R7: 800 ohms, 2 watts.
R8, R9: 300-ohm line cords.
S1: S.P.S.T. switch.
S2: S.P.D.T. switch (opt.).
T: 10,000-ohm midget output transformer (opt.).
2" Permanent-magnet speaker (opt.).

The extra space inside the cabinet will hold either the line cord and coiled antenna, or a 2" speaker.



Angle irons and small bolts hold together a composition-board box.





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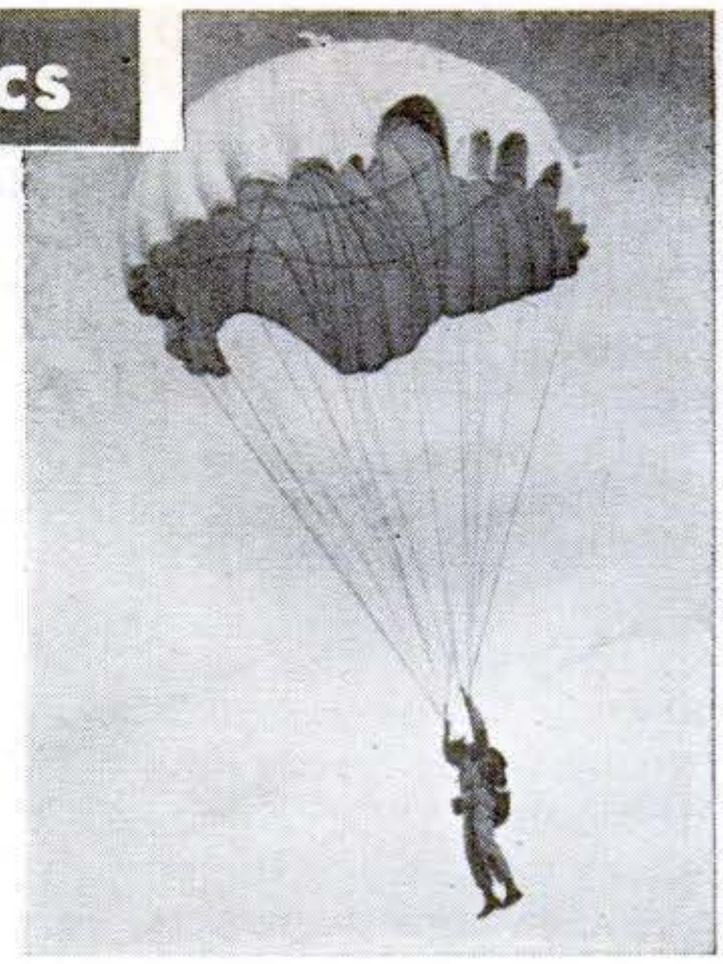
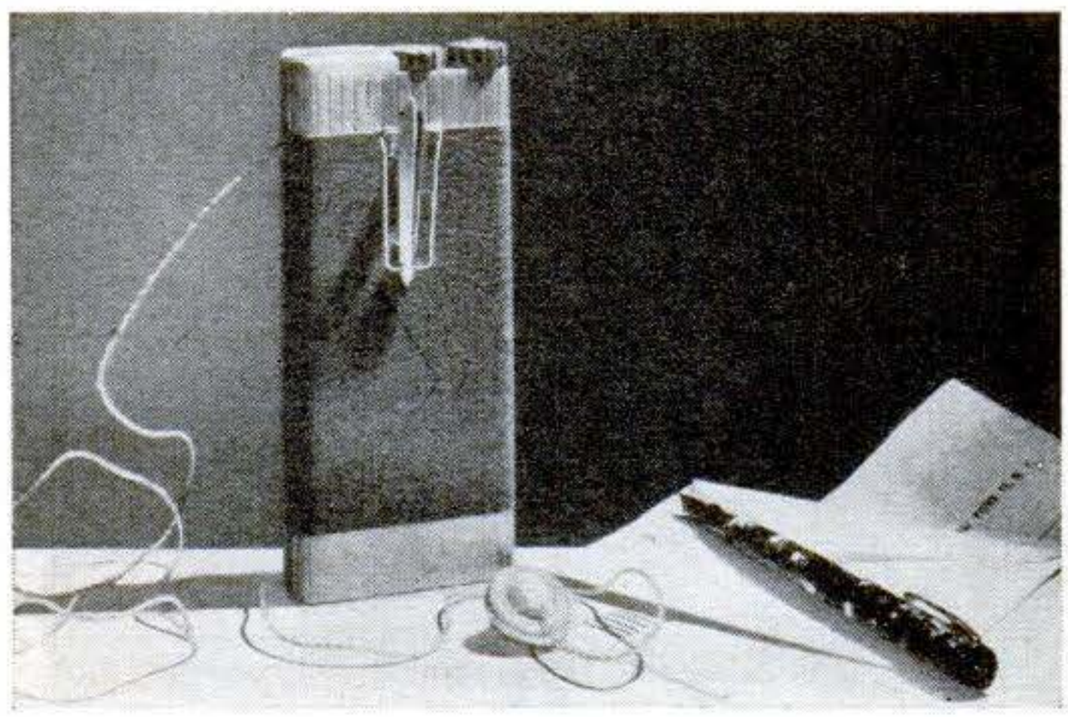
News in Electronics

PARA TALKIE, younger brother of the walkie and handie, was developed by the Michigan Wing of the Civil Air Patrol to enable instructors to speak to students on the way down. Microphone and headphones are built into the chutist's helmet, and the antenna, a length of flat braid, is worn on his trouser leg. The jumper's set is a receiver except when a press-to-talk button is pushed.



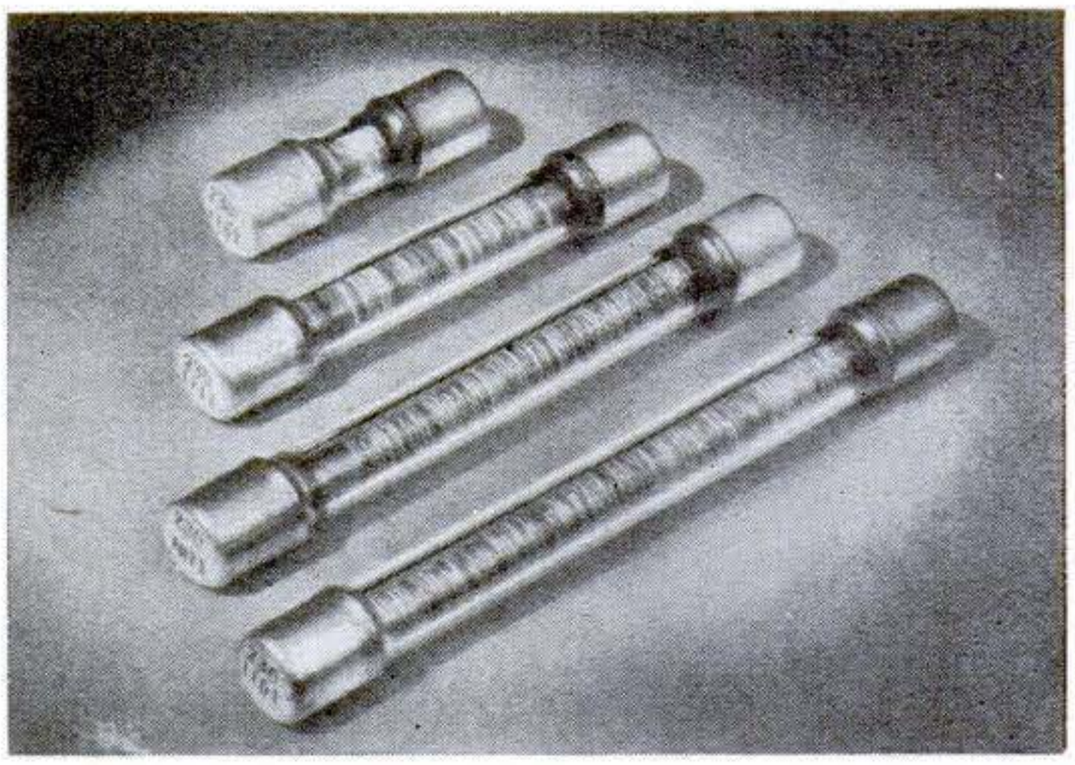


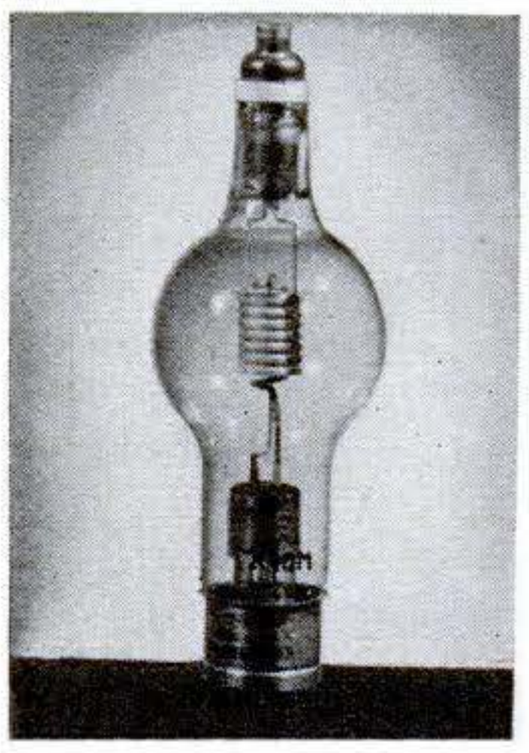
MINIATURE IN MINIATURE. Going small portables a few steps better, the Belmont Radio Corp., of Chicago, has turned out the streamlined, 10-oz. receiver shown at the left. Designed to fit pocket or purse, the set is said to give reception comparable to that of a standard five-tube model. Its compactness is made possible by the wartime development of subminiature tubes for electronic fuses. The set measures ¾" by 3" by 6¼". A lightweight cord connects with an earphone of the hearing-aid type, and a clip holds the set in a pocket.

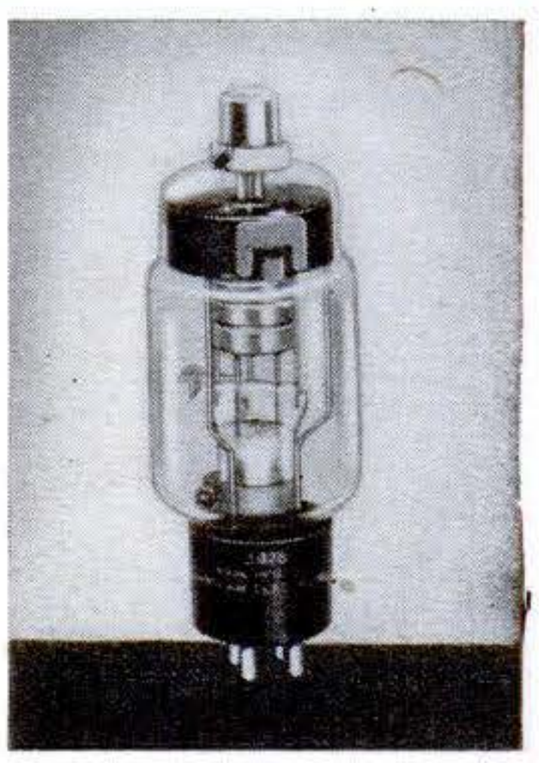
HIGH-VOLTAGE RECTIFIERS are coming to the fore as an ever larger number of electronic devices incorporate the need for large driving potentials. Three of the many new product announcements are illustrated at the right. Four sizes of selenium rectifier stacks, developed by the Federal Telephone and Radio Corporation, are shown in the top picture. Constructed like cartridge fuses, these stacks fit the conventional clips, contact being made through the silver-plated ferrules. Maximum peak inverse voltage ranges from 1,000 to 4,000 volts. The makers expect wide application of these units in television receivers.

Taylor Tubes, Inc., of Chicago, are the makers of the TR-40M shown at the lower left. This is a high-vacuum tube, approximately ten inches tall, and intended for use where space is not at a premium. Peak inverse voltage is rated at 60,000.

Combining some of the features of both mercury-vapor and high-vacuum rectifiers, Chatham Electronics, of Newark, N. J., offers the xenon-filled tube pictured at the lower right. It is made to operate in any position, withstand severe mechanical shock, and deliver up to 6,500 peak inverse volts at 500 cycles.







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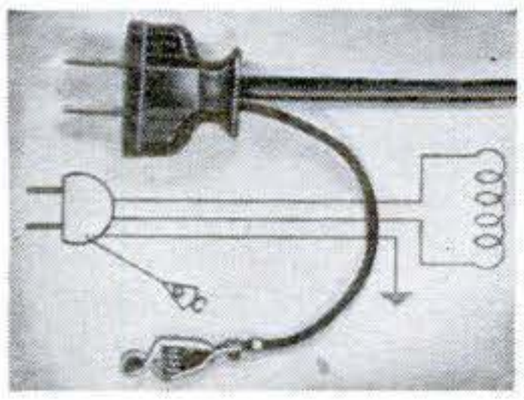
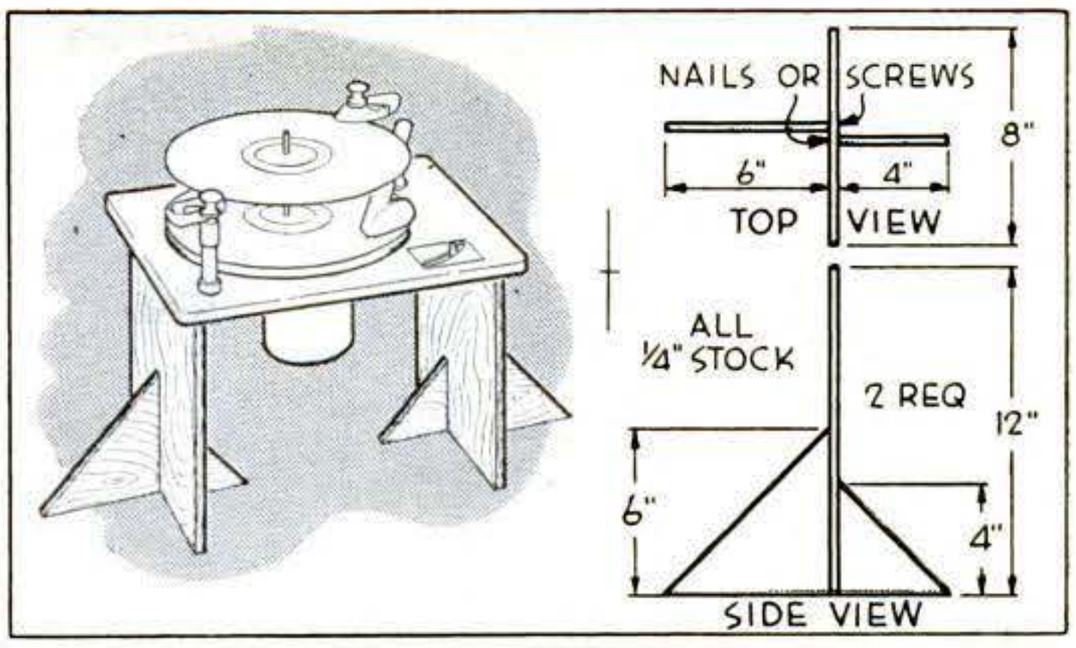
Servicing Hints Wanted

IDEAS that have paid off in your radio work or play can pay off again on these pages. Do you have any short cuts, tips, kinks, hints, or ideas that other experimenters and servicemen can use? POPULAR SCIENCE MONTHLY will pay for all ideas published. Send a brief description, together with a pencil drawing or photo to RADIO EDITOR, POPULAR SCIENCE MONTHLY, 353 Fourth Ave., New York 10, N. Y.

Safety Ground Reduces Danger from High-Voltage Equipment

IN USING high-voltage apparatus around the house, the danger of electric shock may be practically eliminated through the use of a three-wire cord with external ground. Connect one of the wires to the chassis and clip its other end to a wall plate or grounded fixture. Regardless of the voltages used or misused in the equipment, the chassis will always be at ground potential.—G. S.



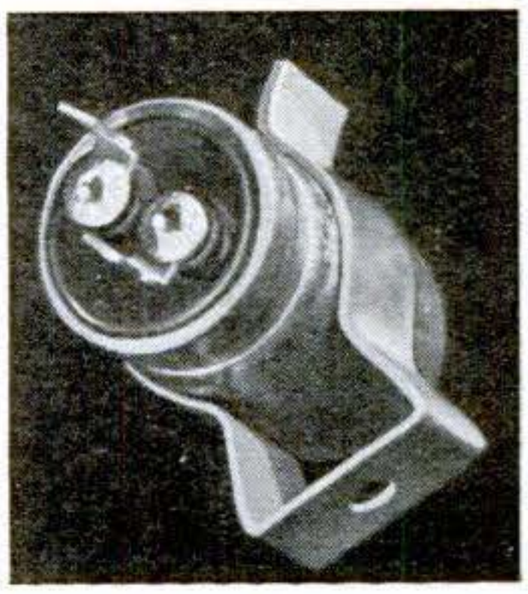


Repair Stand for Record Players

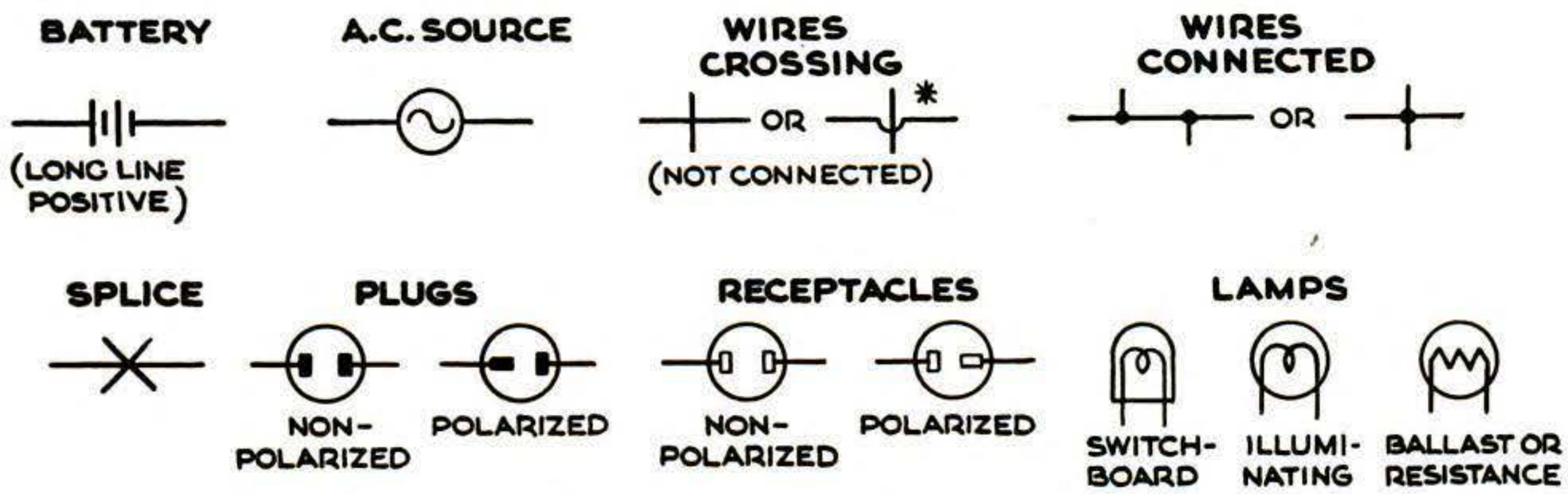
SERVICING a record player or automatic changer outside of its cabinet is usually made difficult by the uneven base of the motor. The stand shown above holds the player in correct operating position, and keeps moving parts clear of the workbench. Any size stock will serve so long as the legs are braced to stand upright. Make two separate legs.—WALTER ANDERSON.

Installing Small Capacitors

LARGE fuse clips can be used to hold small capacitors or other radio components in place as shown. To insulate the condenser, wrap a few turns of cellulose tape around it before slipping it into the clip on the radio chassis.—G. S.



CIRCUIT ELEMENTS [STANDARD SYMBOLS]



Wiring diagrams have become a kind of international language. One of the reasons is that circuit elements have become associated with pictorial symbols that seldom vary. Here are some, selected in part from the American Standards Association's bulletin Z32.5-1944. Those marked * are not used by the Association.

POPULAR SCIENCE MONTHLY SHOP DATA

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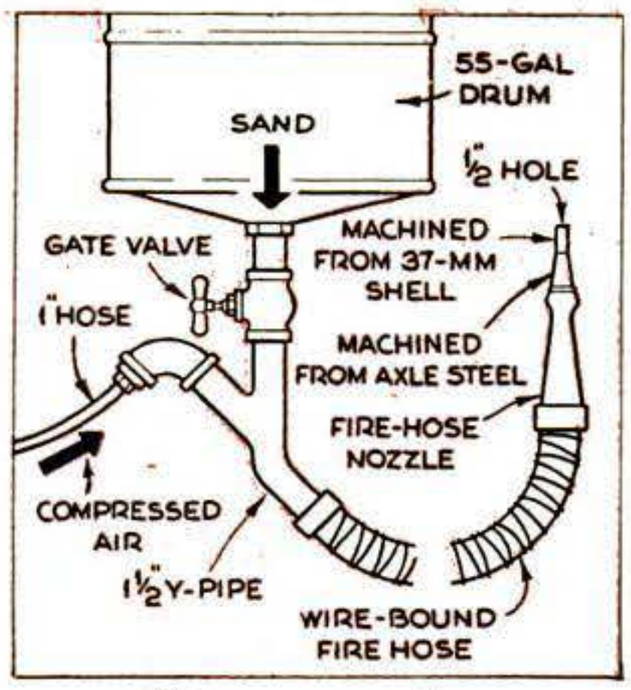
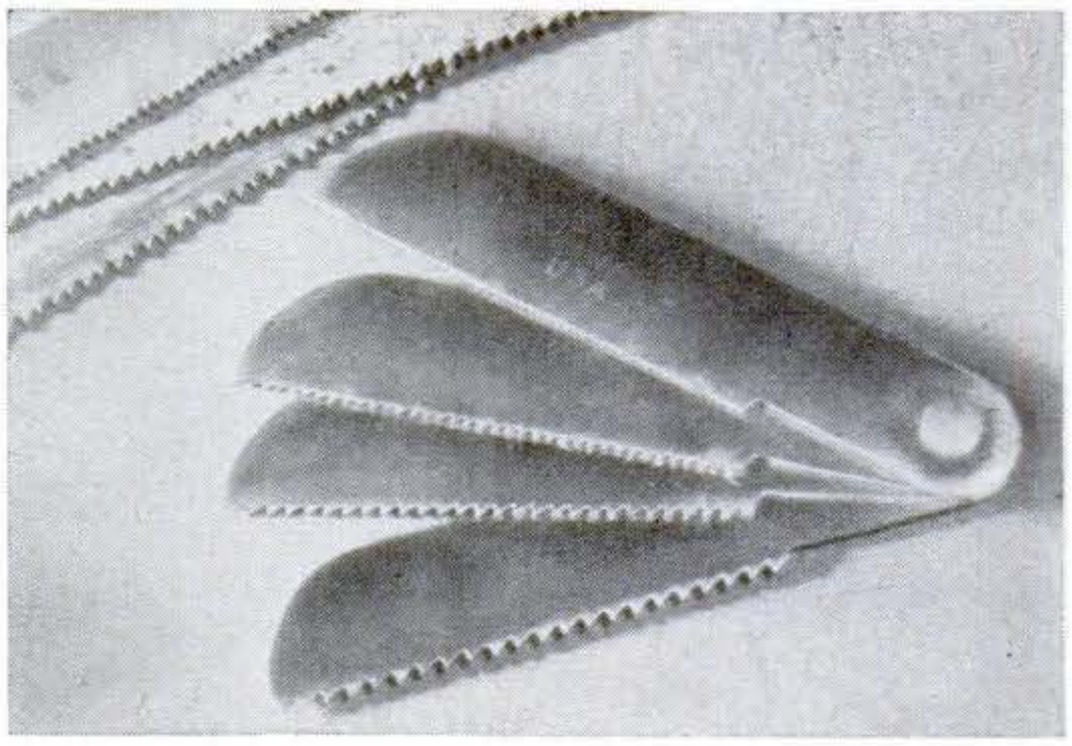


Gauge for Hacksaw-Blade Teeth

UNLESS you are experienced enough to tell the number of teeth on a hacksaw blade at a glance, a gauge like that shown below will save you time. It is made from the ends of four broken hacksaw blades—one each of 14, 18, 24, and 32 teeth.

Grind off the side rake and rivet the pieces together with enough play to permit easy swing. Then grind to shape and remove the burrs.—WILL THOMAS.

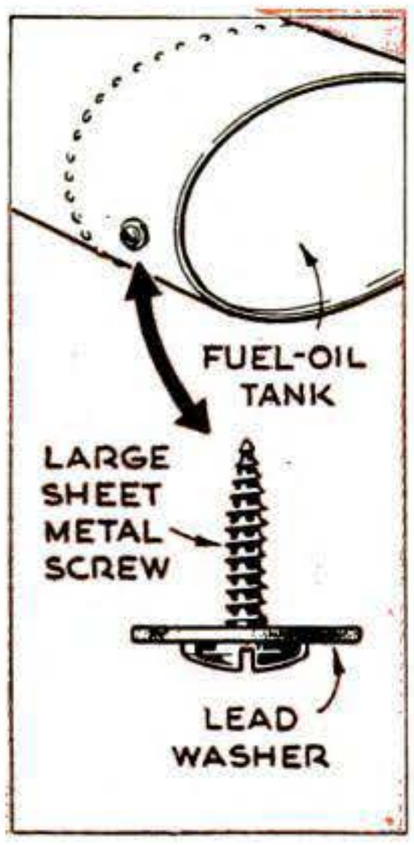


GI Ingenuity and Nazi Junk Pooled in Field Sandblast

MY BOSS, Lt. Russell H. Howard, of Madison, Wis., and I were leafing through POPULAR SCIENCE when it occurred to us that readers might be interested in our improvised field sandblast.

The air compressor was borrowed from battalion headquarters, the wire-bound fire hose and nozzle were salvaged from an inactive fire station, and the oil drum and pipe fixtures were liberated from German military installations. The high-quality steel nozzle resists sand wear.

With the outfit on a trailer, one G.I. was sandblasting rust and old paint off a shipment of 155-mm. projectiles fast enough to keep a crew of POW's busy repainting and stenciling.—RICHARD M. RIEBLING.



Sheet-Metal Screw Plugs Tank Leak

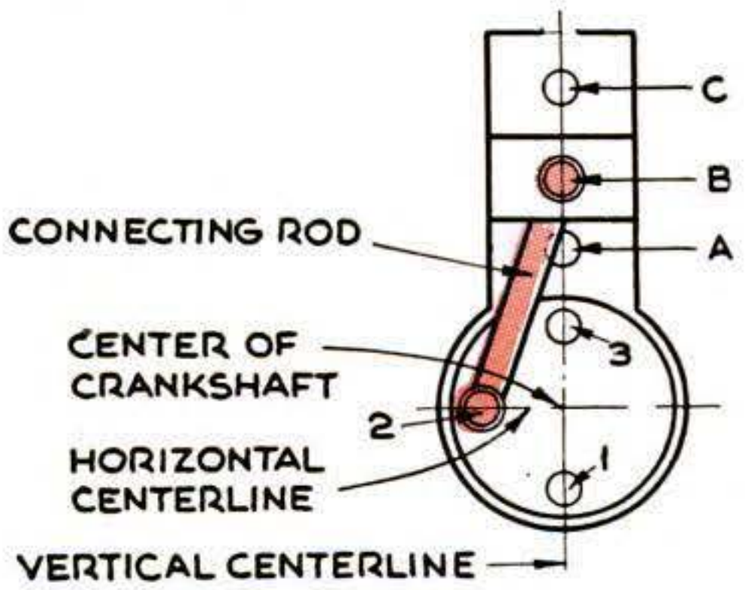
EMERGENCY repairs to a leaking fuel-oil or water tank can be made quickly with a sheet-metal screw and a washer cut from roofing sheet lead. The coarse-threaded screw can be driven in even while the liquid is leaking and will hold the soft lead against the tank.—H. P. S.

HERE'S THE ANSWER TO YOUR CRANKSHAFT PUZZLER

No, the piston pin in the problem on page 161 does not travel the same distance for both 90-deg. movements of the crankpin. Distance *A-B* is less than *B-C*.

The crankpin travels in a circle while the piston pin travels in a straight line, and therefore, when the crankpin is at 2, the con. rod is at an angle from the vertical line of travel of the piston pin. Set a pair of dividers for the length of the connecting rod, swing them down on the vertical line with *B* as a center, and you will find that the lower leg falls slightly below the center of the crankshaft.

Explained by geometry, the connecting rod becomes the hypotenuse of a right-angle triangle with the vertical and horizontal center lines the other two sides. And the hypotenuse is always longer than either of the two sides.



Try your dividers on this drawing; you'll find *B-C* is longer than *A-B*

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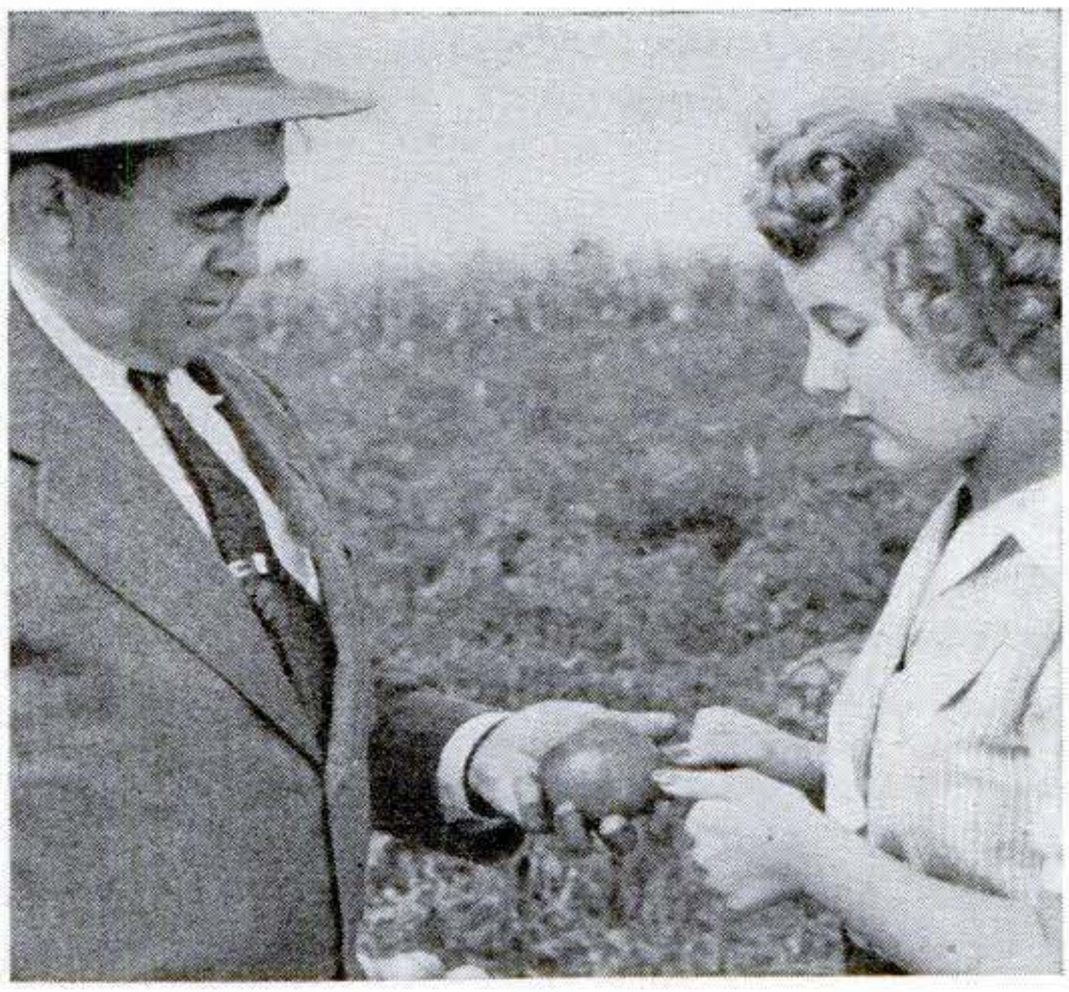
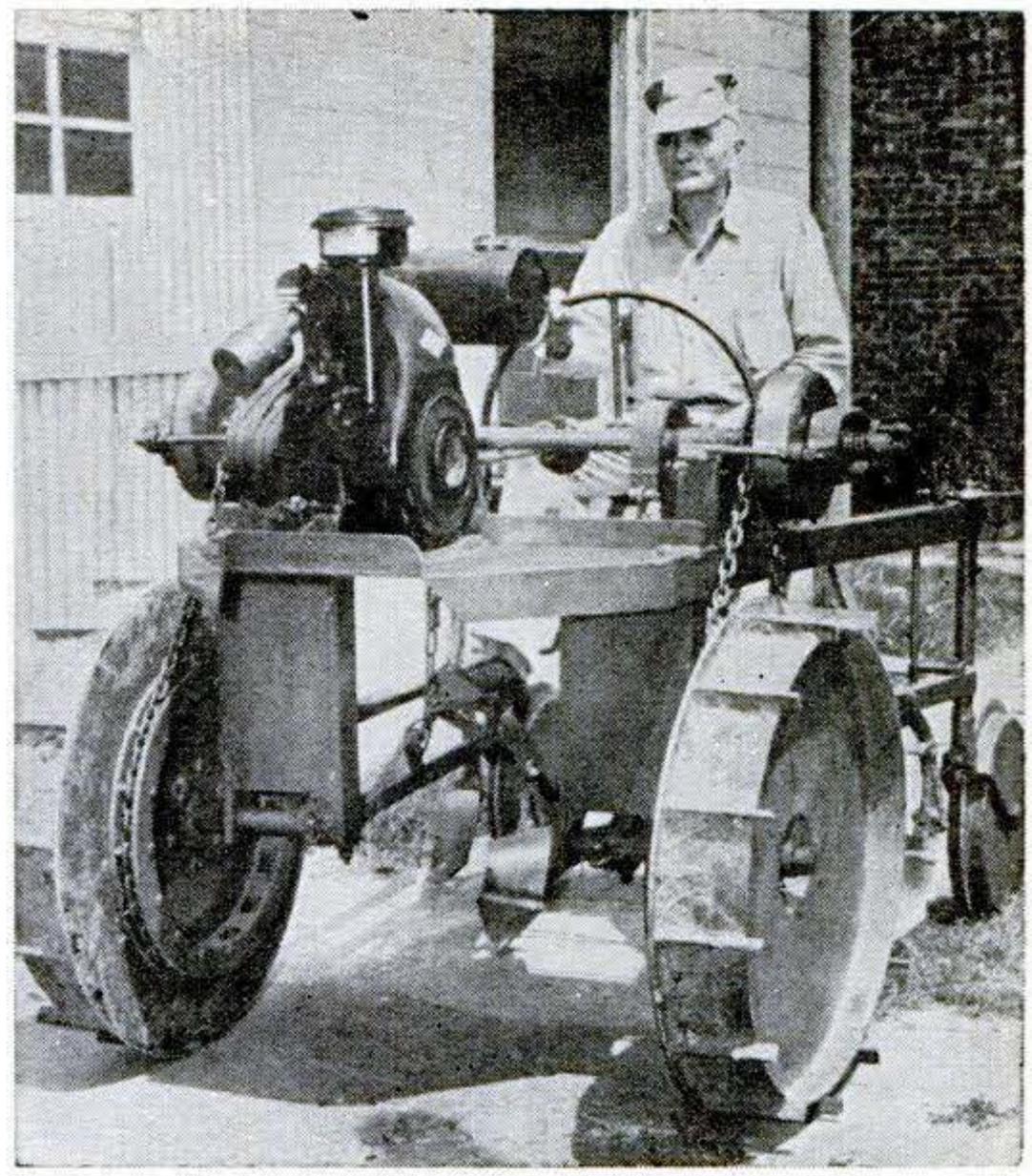
For Easier Farming

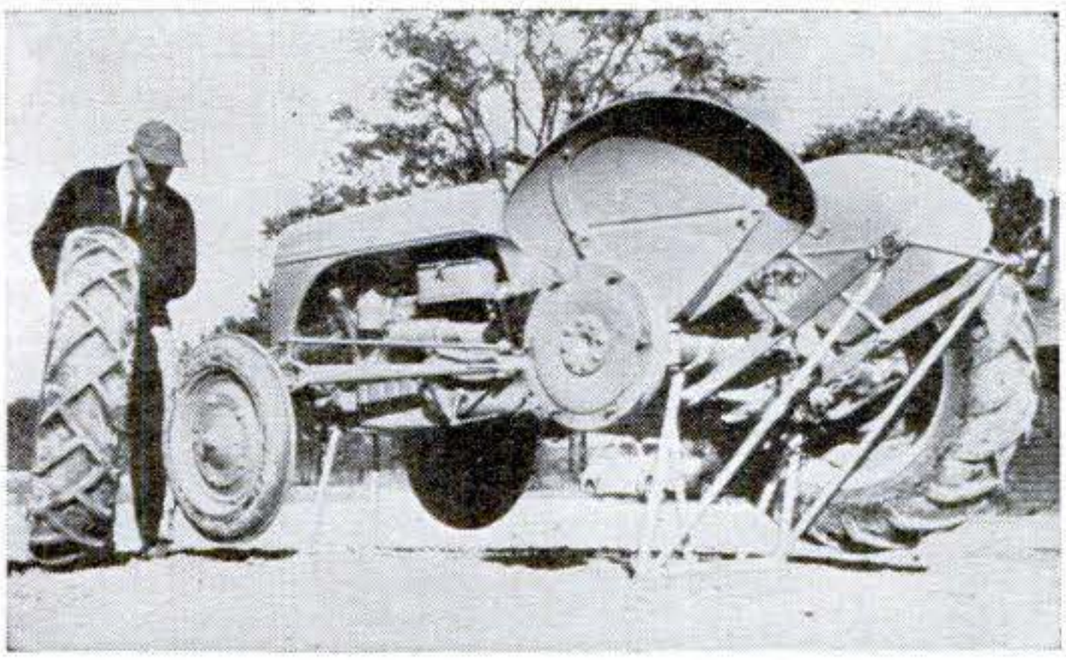
TOMATO-RED POLISH not only looks nice on women's nails, but Prof. Roscoe Fraser, below, of Purdue University, has put it to a practical farming use. Now, when inexperienced young women are hired to pick tomatoes in the fields of southern Illinois and Indiana, they are no longer apt to mix No. 1 and No. 2 grades. They need only look at their thumbs for comparison. Fraser hit upon the idea of painting thumbnails the exact shade of red when he noticed his secretary's nails. Dirt rubs off without marring the polish.





NEEDING A LIGHT TRACTOR, Frank W. Stratton, of Tulsa, Okla., designed and built the machine above, which he believes would be generally useful on small farms and suburban gardens. It is run by a 6-hp. engine and consumes, says Stratton, only two gal. of gasoline in eight hours. Commercial manufacture is planned.

RUBBER HEATING PADS to supply the radiant heat required in brooders are now available as a result of a war development. The United States Rubber Company perfected the technique of changing rubber from an insulator to a conductor during the war to produce heating elements that would prevent formation of ice on plane machine guns and propellers. In use a pad is cemented inside the roof of the brooder. It supplies uniform heat over the brooder area.



IT JACKS ITSELF UP, this new Ford-Ferguson tractor produced by Harry Ferguson, Inc., of Detroit. When a tire is to be changed or the treads need cleaning, light tubular frames are placed under the axles, the rear end is connected to the two arms of a hydraulic linkage, and the jacking operation is performed through a control lever near the driver's seat. The entire tractor can be lifted 4" off the ground. The time required to reach this maximum height is a bit less than one minute.

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ELECTROLYSIS . . .

Working Together, Electricity and Chemistry Perform Many Industrial Chores. These Experiments Show How They Do It

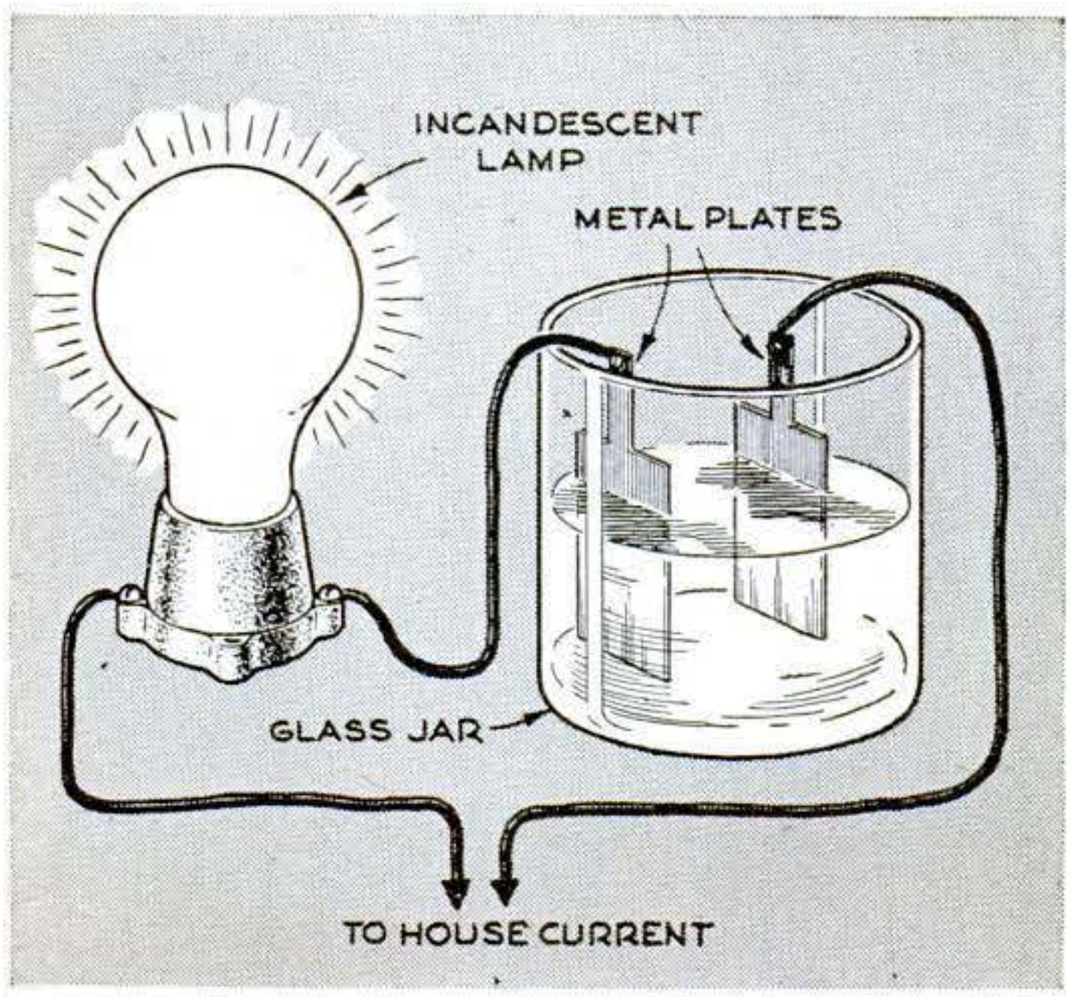
By KENNETH M. SWEZEY

BY SENDING an electric current through certain melted salts or conducting solutions, the modern chemist performs an almost endless variety of industrial chores. He extracts metals from their ores, plates expensive and hard metals on baser or softer metals, and produces vast quantities of such important compounds and elements as aluminum, magnesium, sodium, chlorine, hydrogen, and sodium hydroxide.

This is accomplished by electrolysis, a process in which electricity passes through a conducting fluid. Liquids that conduct electricity may be divided into two classes—metals in a liquid state, and salts, bases, and acids in solution or fused. In the first, the melted metals conduct electricity in the same way they do in a solid state. In the second, chemical changes occur. Electrolysis employs the second.

The apparatus shown below will enable you to demonstrate how such a liquid conductor is produced. So long as the beaker contains nothing except pure water, the bulb will refuse to light. If you drop in some sugar, there still is no change. But add just a little salt, and the light begins to glow.

When certain salts are fused, and when acids, bases, or salts are dissolved in water, the compounds promptly break up, or *dissociate,* into *ions.* These ions are atoms or groups of atoms which have become positively or negatively charged because of the loss or gain of electrons. For example, when common salt (NaCl) is dissolved in water, the molecules dissociate into sodium ions and chlorine ions. In this process of breaking up, each chlorine atom grabs an extra electron and adds it to the total normally carried when combined with a sodium atom as a salt molecule. This additional electron gives the chlorine ion a single negative charge. Left with a deficit of one electron, the sodium atom consequently attains a single positive charge.



Some liquids conduct electricity readily; some do not. If the beaker above contains only pure water, nothing happens. But add salt, and the light glows.

Because of the electrical charges they carry, ions behave quite differently, both chemically and electrically, from the neutral molecules. Put electrodes connected with an electric generator or battery into an ionized solution, or *electrolyte,* and what happens? Negatively charged ions move toward the positive electrode, or *anode,* and positively charged ions toward the negative electrode, or *cathode.* Reaching their respective electrodes, the ions are neutralized, and presto! they are promptly changed back into plain atoms.

Sometimes an amazing electrochemical change occurs without the application of external current. As an example, dissolve some copper sulphate in water in a test tube. This makes a deep blue solution. Now add a little zinc dust, stopper the tube, and shake it for a minute or two. While doing this you will notice that the tube becomes quite warm. After shaking the tube, let the solid matter settle. Instead of blue, your solution now should be the color of water, while at the bottom, in place of zinc, you will have copper!

This is a case of one metal (zinc) displacing the ions of a less active metal (copper). Each copper ion originally had two positive charges. The zinc atoms neutralized these by each giving up two electrons. As a result, the copper ions were changed to copper metal, while the zinc went into solution in its ionic form.

As your first experiment in actual electrolysis you could make a little lithium.

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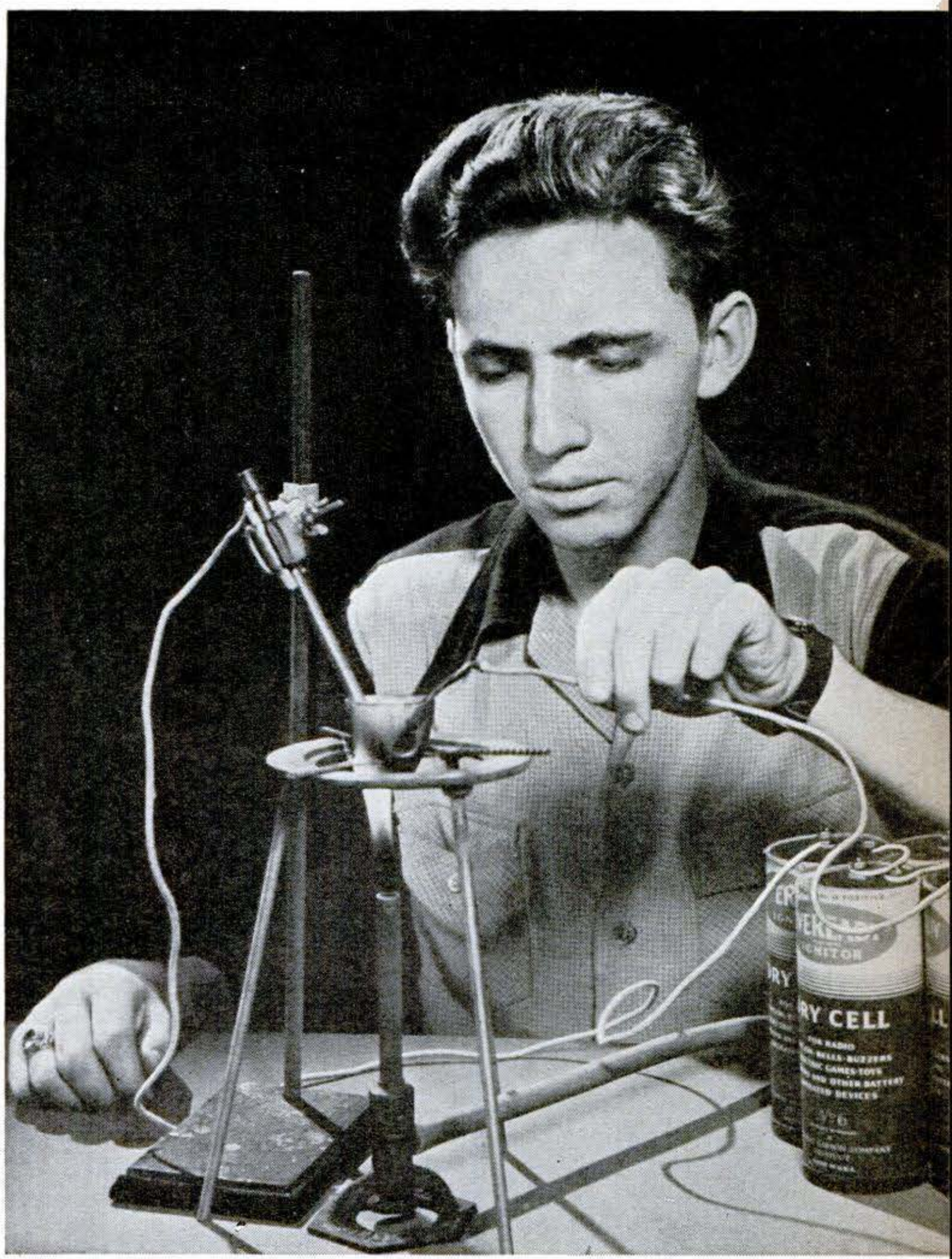
With this apparatus, an experimenter can produce small amounts of lithium as one demonstration of electrolysis.



Except for frozen hydrogen, this is the lightest solid known. The apparatus you will need is shown in the photograph on this page. A small porcelain crucible over a Bunsen burner will serve as your furnace, a carbon from an ultraviolet lamp as your anode, and a short length of iron wire with a small loop bent in its lower end as your cathode. Four dry cells connected in series will furnish adequate current. The anode should, of course, be connected to the positive terminal of this battery, and the cathode should be connected to the negative terminal.

Melt about ¼ oz. of lithium chloride in the crucible, and then insert the electrodes so that they dip well into the solution but do not touch. Soon after you have immersed the electrodes, a silver substance will begin forming on the loop at the end of the cathode. This is the metal lithium.

When a little bead has formed, remove the wire carefully, immerse it in a small bottle containing kerosene, and shake the wire to dislodge the globule of metal. Because lithium reacts with the moisture in the air it should always be kept under kerosene when not being used. Continue collecting the metal until you have enough for a fair sized bead. Then remove the bead from your bottle with a pair of tweezers and place it on the surface of some water in a beaker. It will float high and dart about, releasing hydrogen and forming lithium hydroxide with the water.

Sodium metal and chlorine gas are produced commercially by electrolyzing common salt that has been fused, the chlorine ions being transformed into chlorine gas at the anode and the sodium ions into sodium metal at the cathode. The salt must be fused for this process, for if a solution were used the sodium would produce a secondary reaction with the water. Since salt has too high a melting point to be fused readily in the home laboratory, it would be impracticable for you to attempt any experiment involving production of sodium metal and chlorine gas. But there is another form of electrolysis involving salt that you can try.

By passing an electric current through a strong solution of salt water, chemists produce chlorine, hydrogen, and sodium hydroxide on a large scale. Chlorine forms at the anode while the sodium produced at the cathode reacts with the water, yielding sodium hydroxide and hydrogen. A porous partition of asbestos cloth between the electrodes keeps the chlorine from mixing with the sodium hydroxide.

You can readily produce all of these with the help of a U-tube, some strong salt water, and your four-cell battery. Your electrodes can be made from the carbons taken from two small flashlight cells. Apply a coating of paraffin to the connecting wires at the points where they are wrapped around the electrodes. This protects the wires from the solution. A disk of asbestos slightly larger than the inside diameter of

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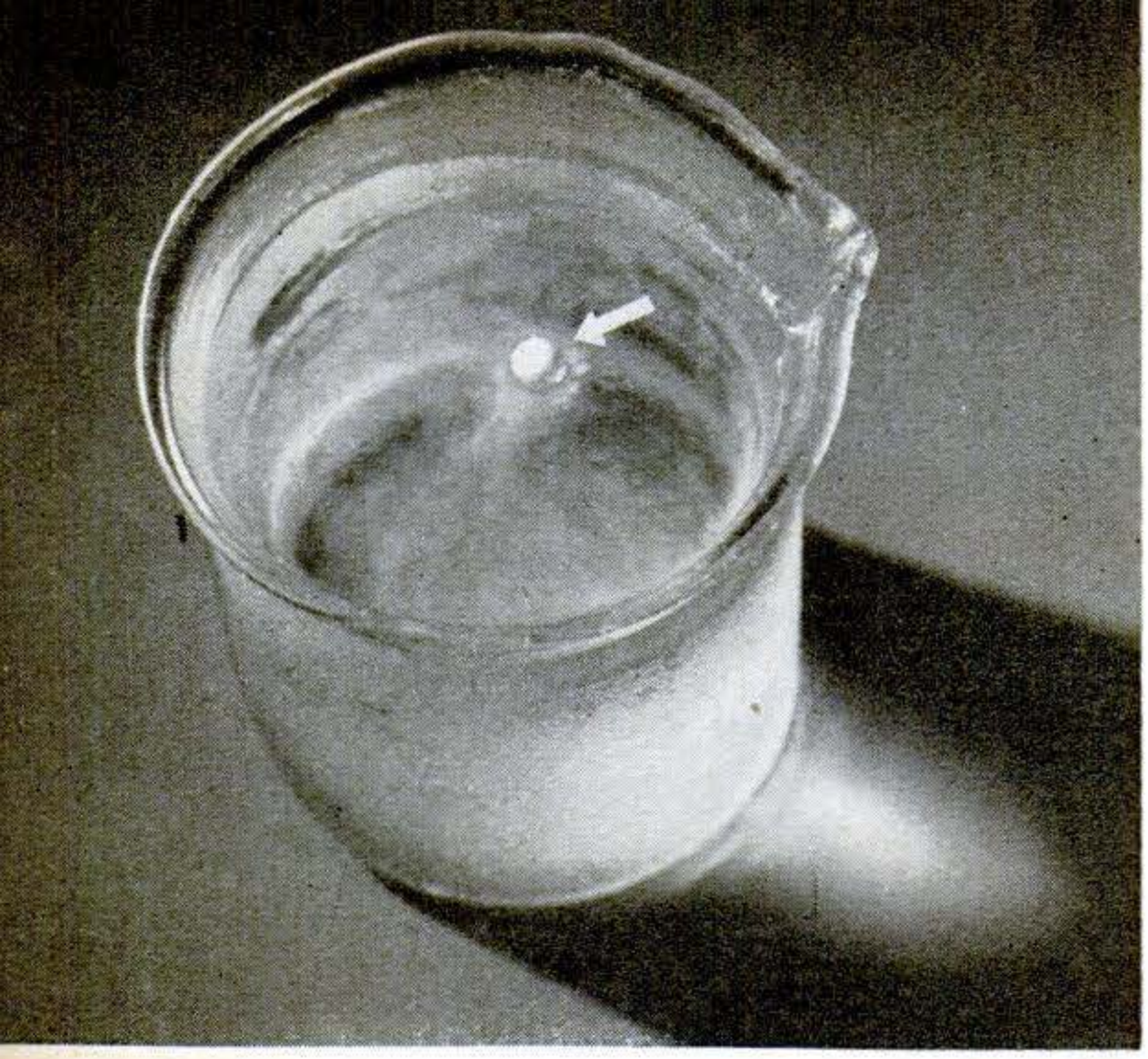


If floated on water, a bead of lithium darts over the surface, decomposing the water and giving off hydrogen. Lithium is one of the lightest solids.

the tube should be carefully wedged about two-thirds of the way down the anode arm.

You may test for chlorine by causing this gas to bleach out a strip of colored cloth in a length of tubing placed above the anode leg of the U-tube and connected to it by a small glass tube. The top stopper in the upper tubing should have a small hole in it to let the chlorine pass out slowly. You may obtain a more positive bleaching action by dyeing a piece of cloth with ink and using it while still moist. A few drops of phenolphthalein solution added to the electrolyte in the cathode arm of the tube will give you a test for sodium hydroxide. A strong pink coloration will indicate that sodium hydroxide has been produced.

By putting a solution of potassium iodide in the U-tube instead of the salt water you will get a reaction that is plainly visible. As soon as the electrodes are connected to the battery, negative iodide ions are attracted to the positive electrode. When they reach this, they are neutralized, giving up their negative charge and becoming common atoms of iodine. You will recognize this iodine as it streams down.

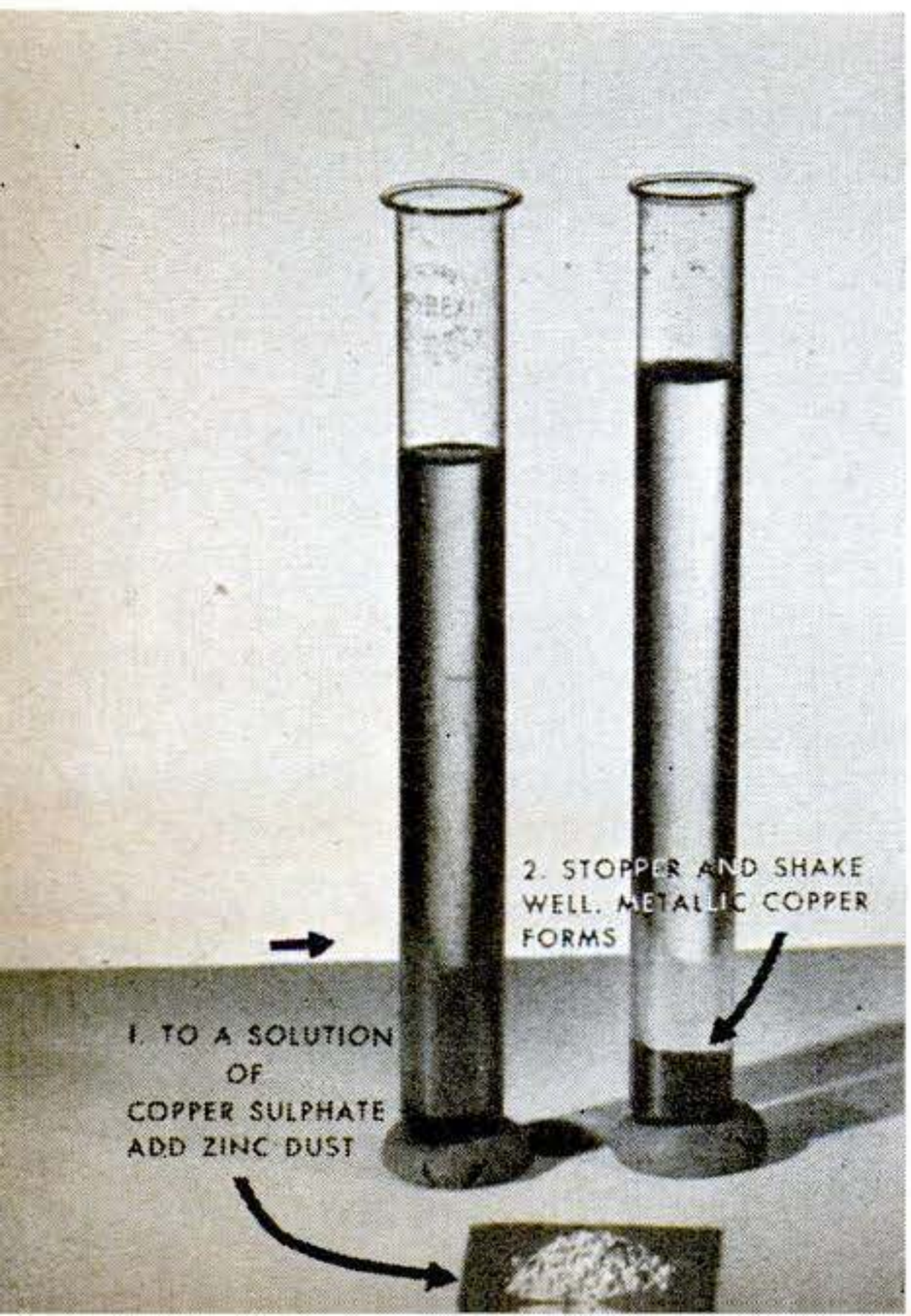
Using the same apparatus you can also grow a pretty "tree" of tin within a few minutes. This time use a solution of tin chloride (stannous chloride). You can make this by dissolving about ½ oz. of the chemical in 4 oz. of water, then adding just enough hydrochloric acid to cause the solution to become clear. Use a bare copper wire for the cathode instead of carbon.

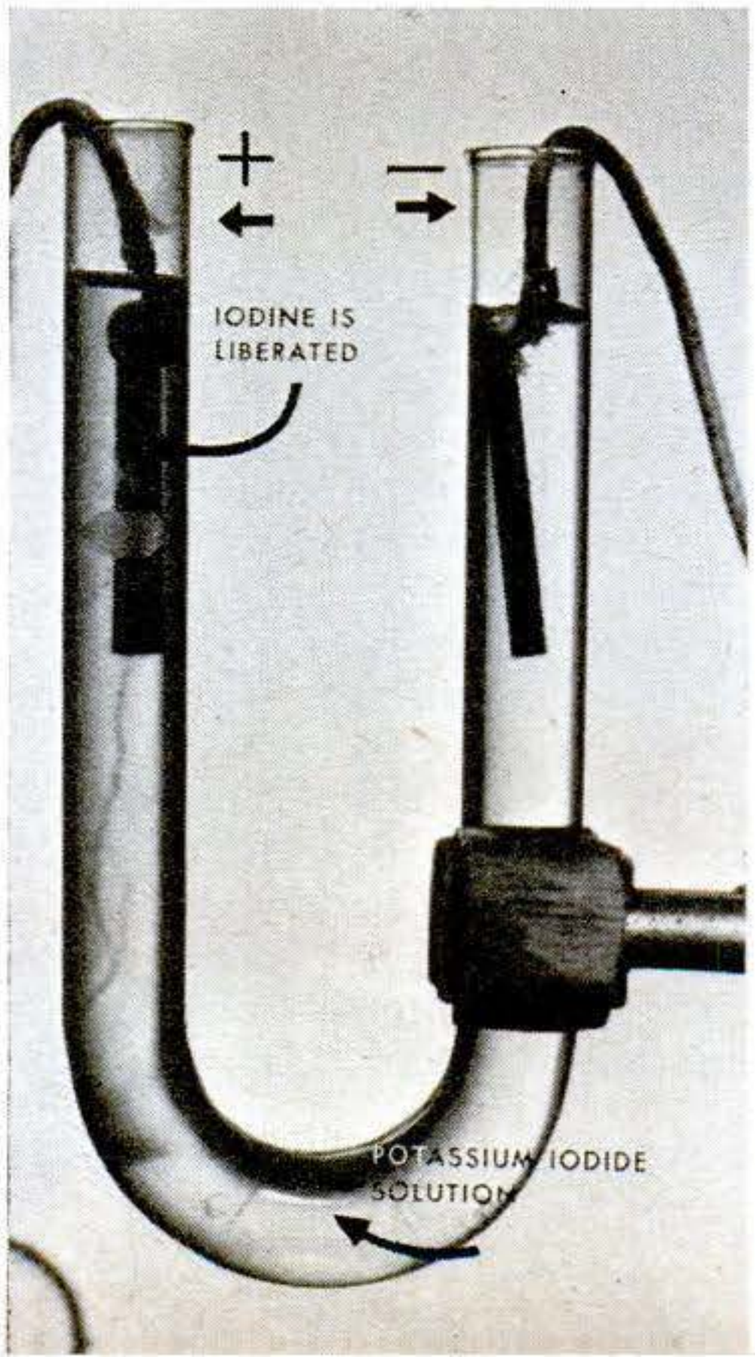
As soon as the battery is connected, tin crystals will begin to form on the copper wire. A tree several inches long should form while you watch.

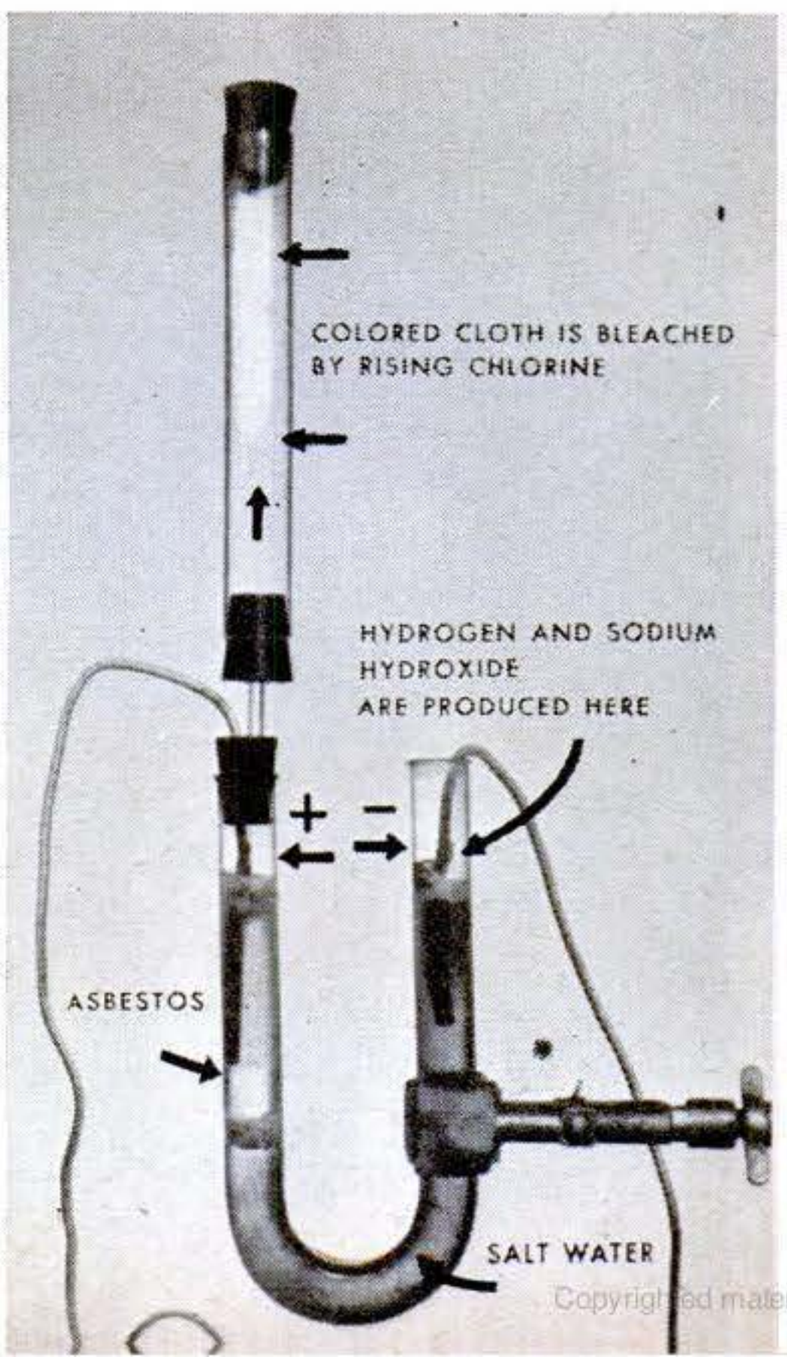
Plating metals by electricity is one of the most important and familiar branches of electrolysis. The electrochemical activity in this case is the same as in the previous examples. Electrodes are placed in a solution of a salt of the metal to be plated and a current is applied. Positive ions of metal are drawn to the cathode and are there deposited as atoms of the metal.

Because the anode generally is made of the metal that is being plated, it is commonly believed that by some means the electric current takes metal from this anode plate and directly carries it over to the

Electrochemical changes may occur, as at the left, without any external current. In this particular case, zinc atoms neutralize copper ions, changing them into copper metal. Center, iodine results when current is passed through the solution. Right, a salt solution yields chlorine, sodium hydroxide, and hydrogen.







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cathode. That this is not true can easily be proved with an electroplating experiment.

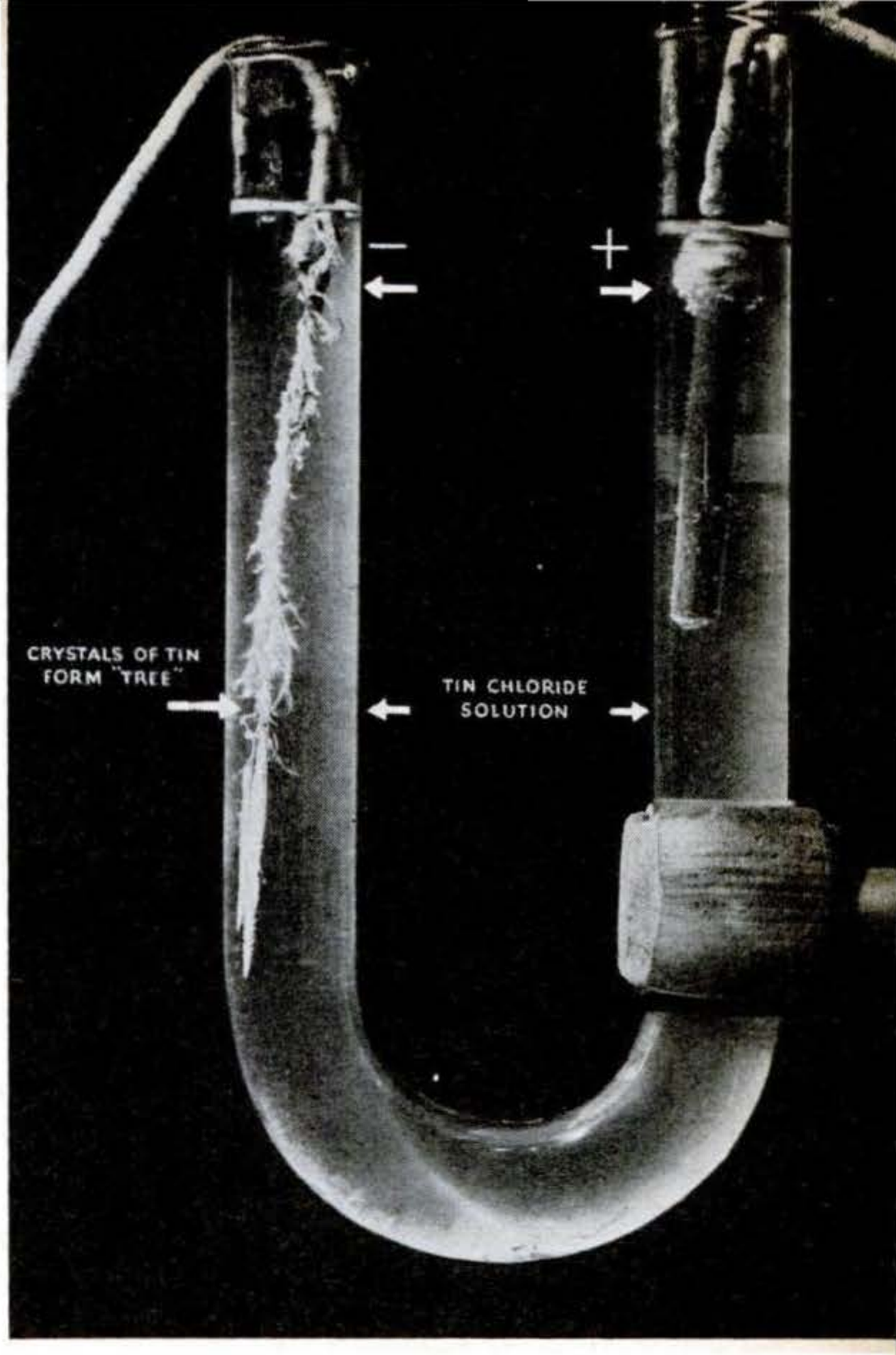
Make a plating bath by dissolving about 1 oz. of copper sulphate in 4 oz. of water and adding carefully about ⅛ oz. of concentrated sulphuric acid. For electrodes again use two carbons from old flashlight cells. By clamping these, as shown below, between two small sticks with the help of rubber bands, you can regulate the flow of current by altering their spacing.

This time two dry cells connected in series should provide about the right amount of current. If the current is too great, the coating of metal is likely to be coarse, and it will not adhere as it should.

Copper soon starts to deposit on the cathode when current is applied. Since the anode is carbon, the copper could come from nowhere except the solution. Within 10 or 15 minutes the coating on the cathode should be heavy enough to take a polish.

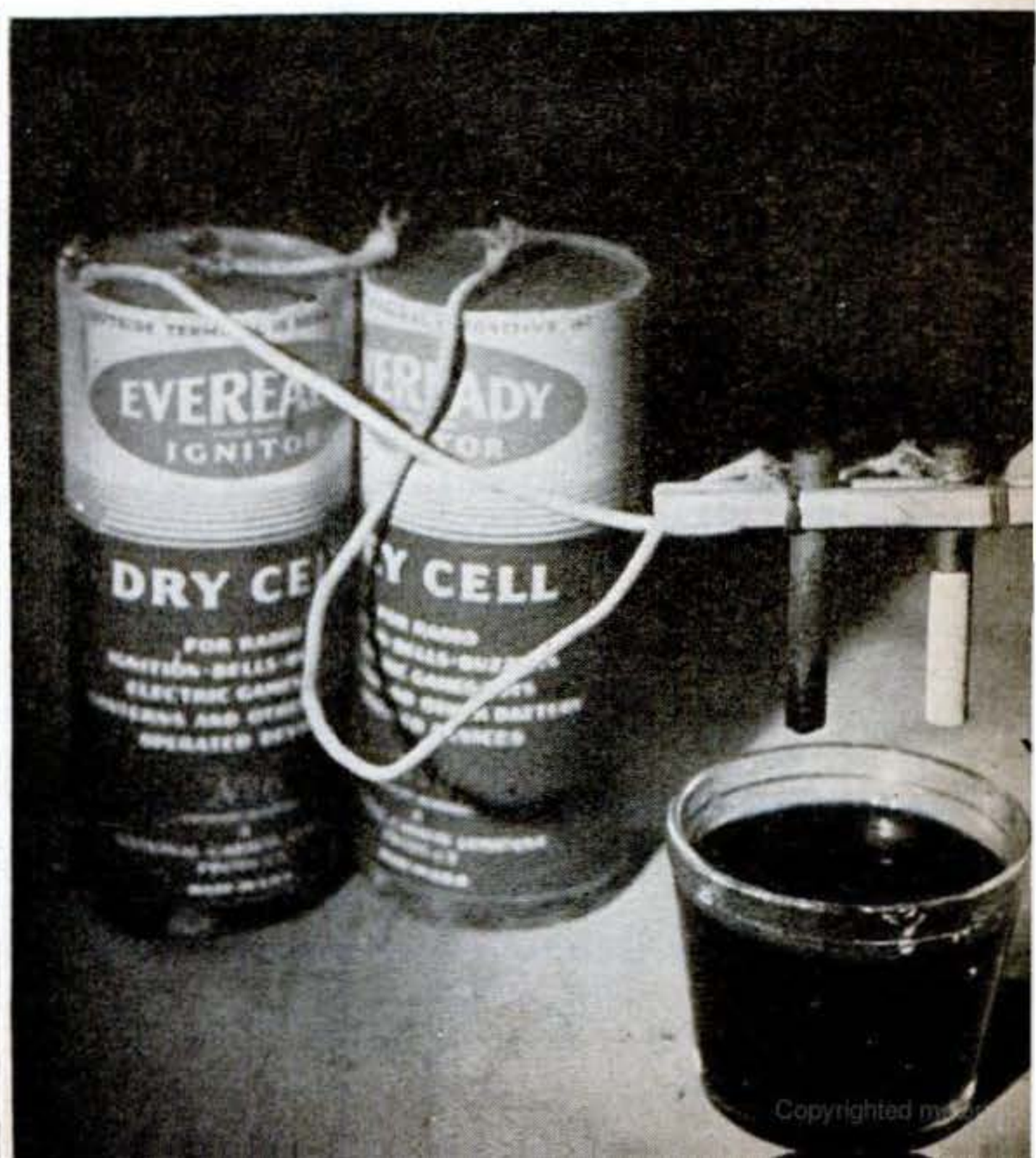
If you want to prove to yourself more definitely the action of the current, reverse the connections to the batteries, the positive lead this time going to the electrode that has the coating of copper. In about the same time that it took to plate the original cathode, the new cathode will become plated. The old cathode will lose all its copper.

But this does not mean that any of the metal will have been transferred directly to the new cathode. Instead, it will have gone into solution to help replenish the ions changed into metal at the cathode. This is exactly what happens in electroplating when the anode is made of the metal that is being plated. The anode gradually dissolves to help keep the electrolyte up to par.

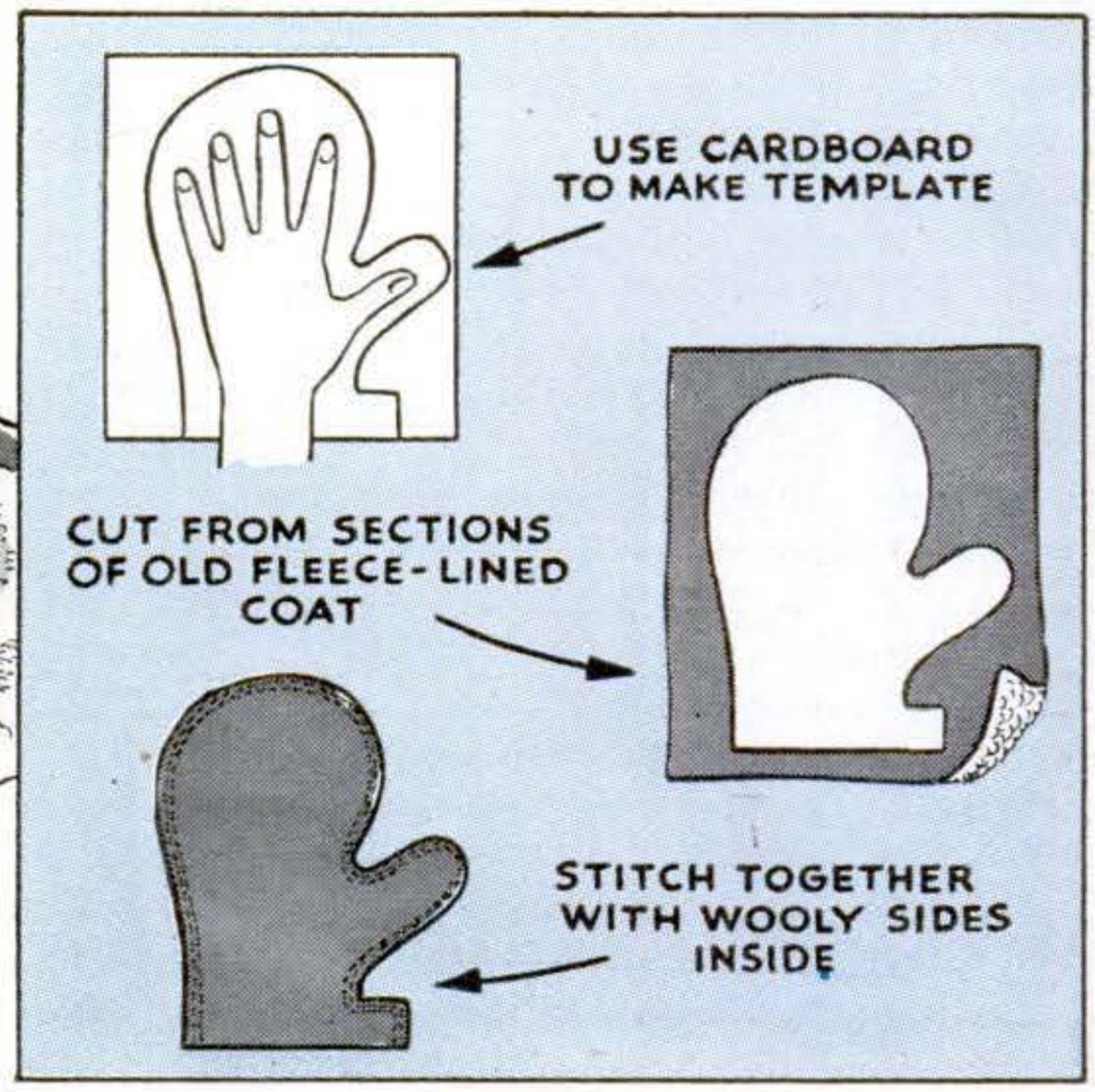


Pretty crystals of tin form on the cathode in the shape of a glittering tree when current is passed through a solution of tin chloride to which just a little hydrochloric acid has been added. For this experiment, use a bare copper wire as the cathode. The anode is a carbon from an old flashlight cell.

In electroplating, positive metallic ions are neutralized and coat the cathode as atoms of the metal. At left, the cathode is plated with copper when carbon electrodes are immersed in copper sulphate electrolyte. Right, switching leads plates the new cathode and causes the copper on the old one to return to solution.



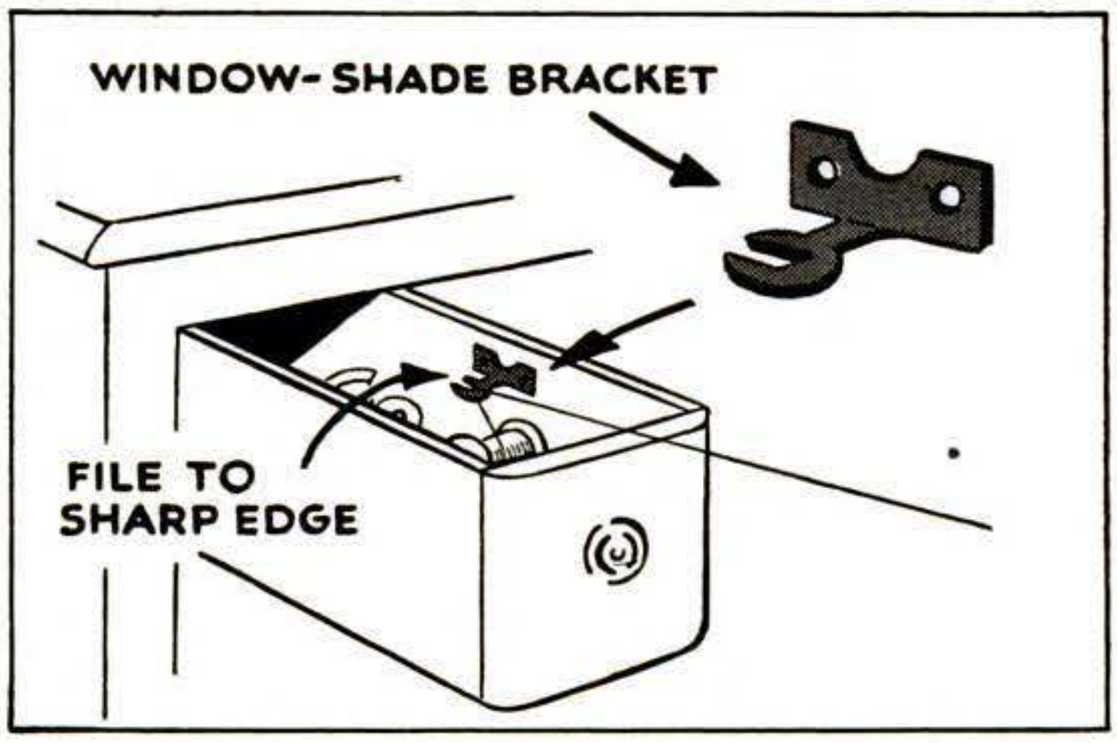
KEEPING



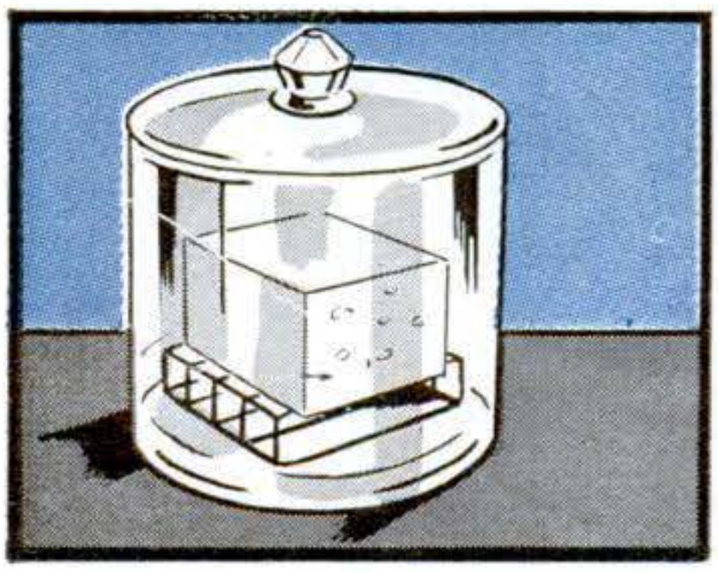
Warm ski mittens can be stitched up from pieces cut from an old fleece-lined coat that is ready for the discard. The fleece is, of course, used inside, and the stitches are put on the outside.

Boiling followed by a simple rinse will renew an old dust mop. Add a tablespoonful of soda and two of paraffin to the first water and 10 drops of furniture polish to the rinse. Then let the mop dry. The treatment can be repeated frequently.

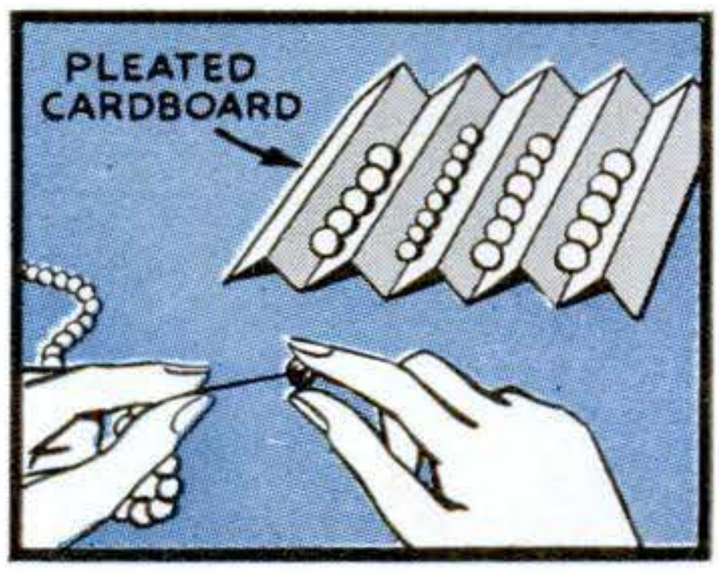
Screwed to the inside of a sewing-machine drawer, as indicated below, the notched member of a pair of window-shade brackets becomes a handy thread or string cutter. File the notch to a knife edge and attach the bracket near the top of the drawer.



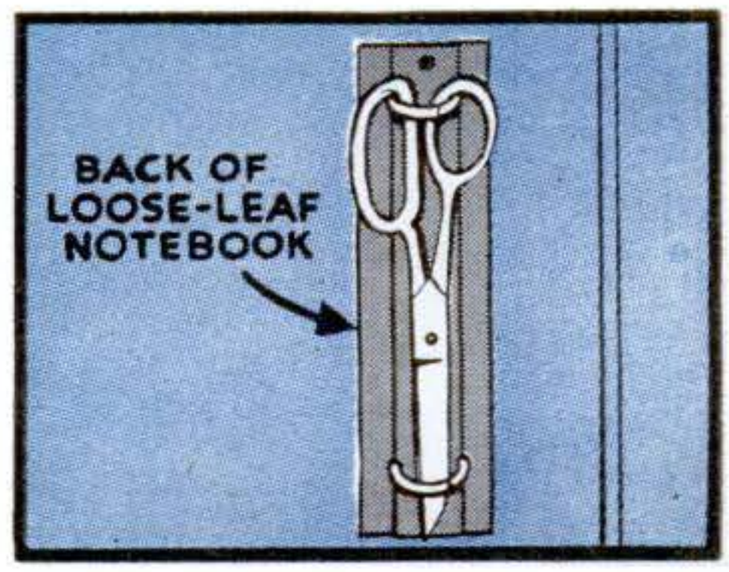
Cheese won't dry out if kept on a wire rack in a covered jar having a little water or vinegar in the bottom. A glass humidor with a patented humidifier is excellent.



Folding a piece of cardboard in pleats provides a ready rack for various small parts. One use is for separating beads into sizes when restringing is being done.



Tacked up in a closet, the ring binder and back of a loose-leaf notebook is a convenient hanger for scissors. Open the top ring to slip it through the handles.



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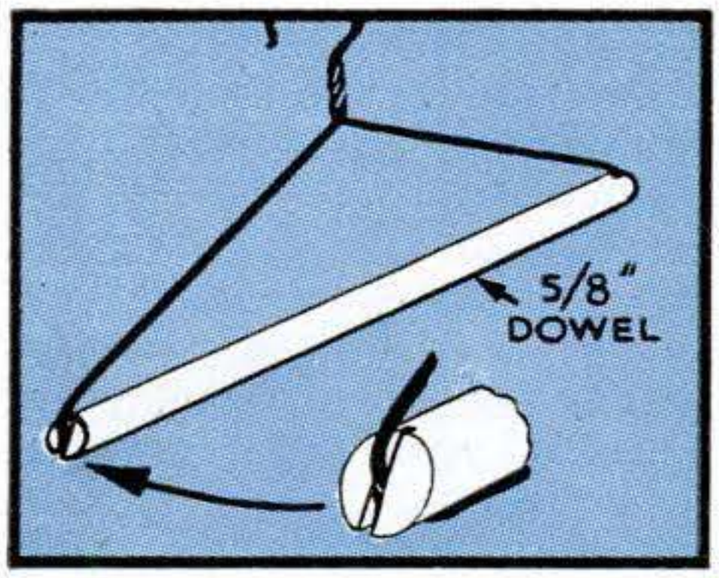
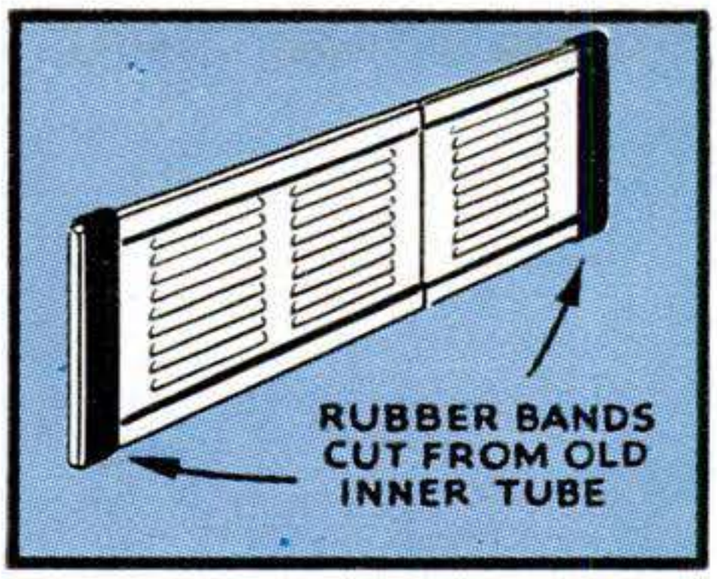
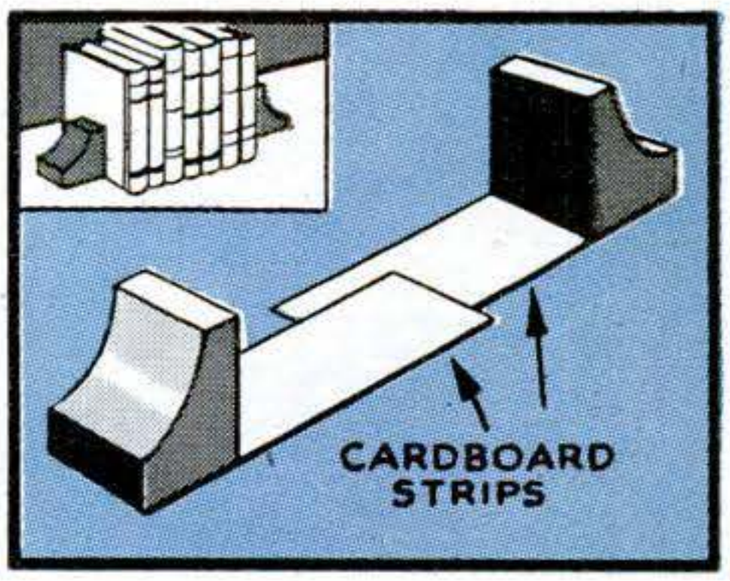
THE HOME SHIPSHAPE



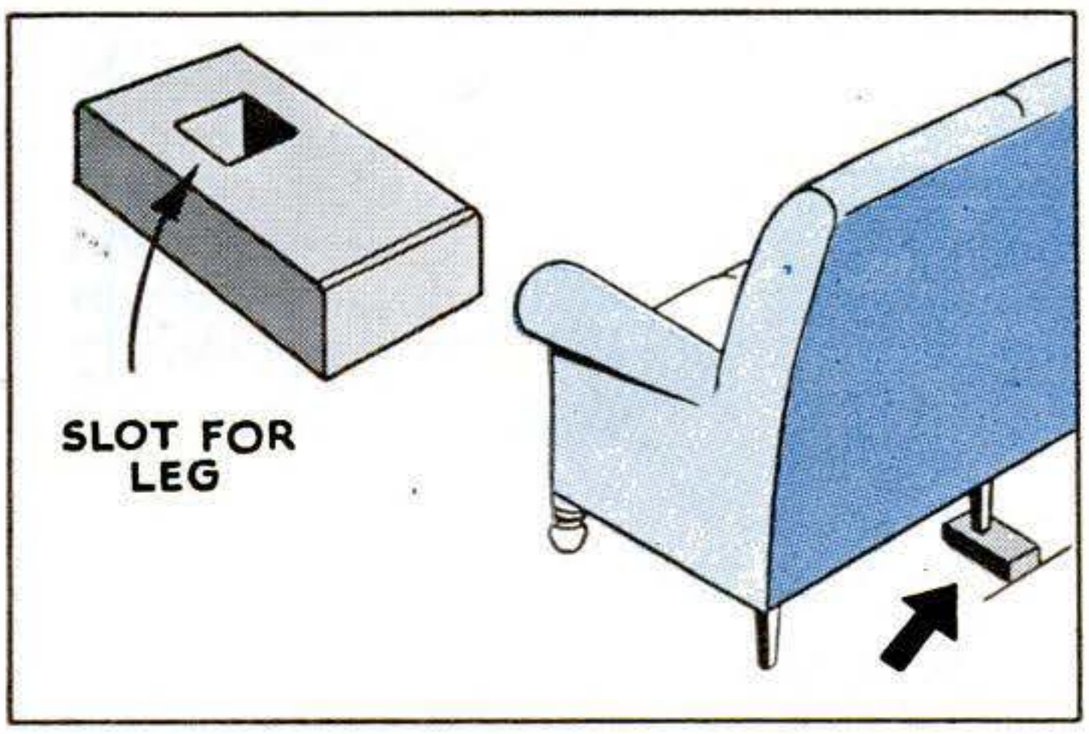
Wire coat hangers won't make an unwanted crease on trousers or skirts if fitted with a dowel notched at both ends and sprung into place above the cross rod.



If metal window ventilators fit so poorly they rattle every time the wind blows, cushion them at both ends with rubber bands 1" wide cut from an old inner tube.

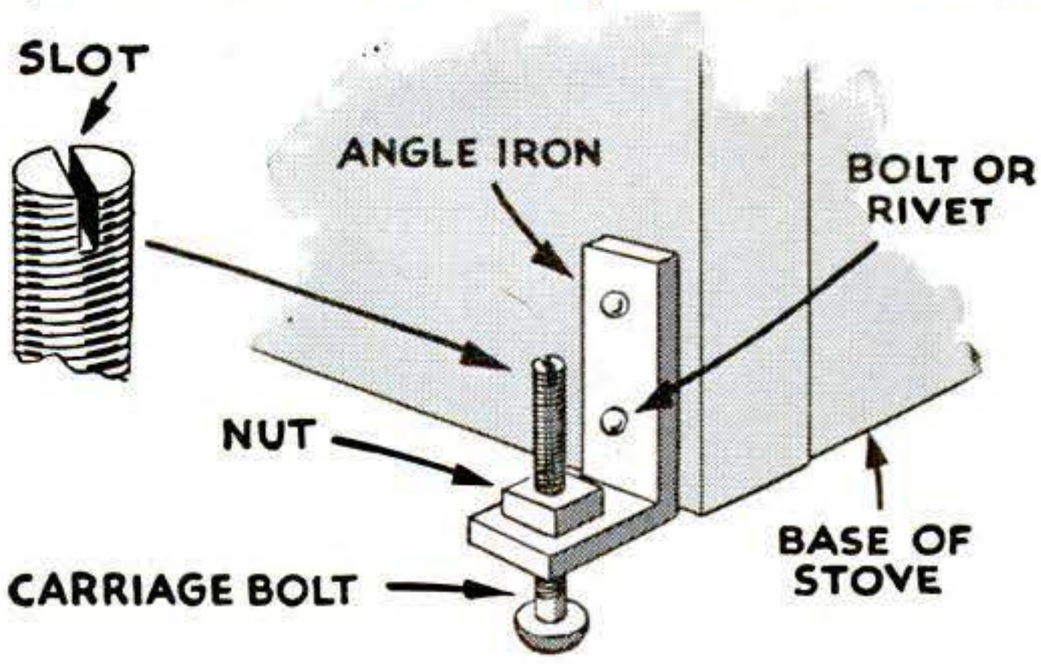


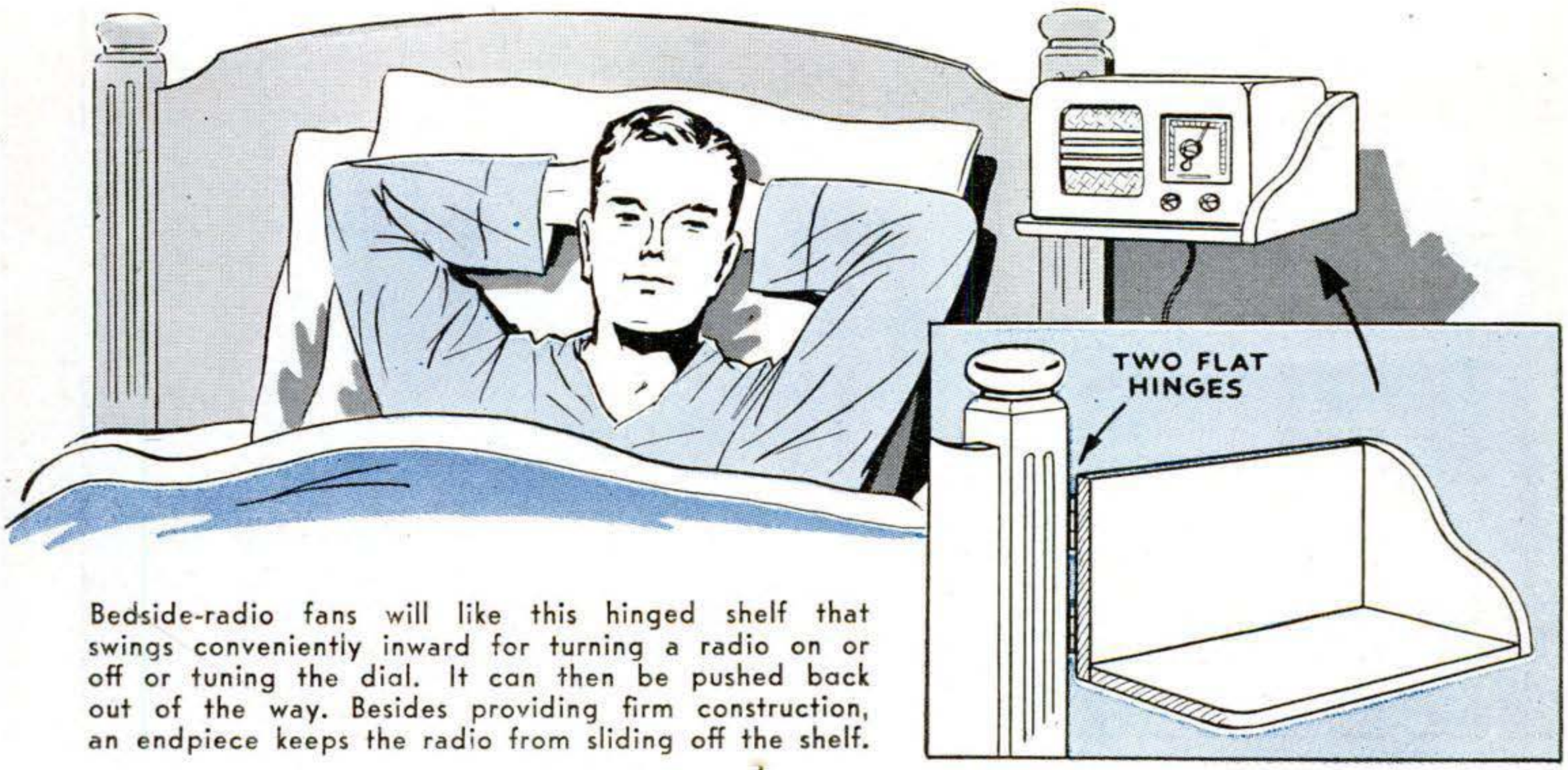
Book ends that tend to slide out or fall over because of lightness may be provided with firm anchors by gluing cardboard strips under them. The strips overlap.



Furniture that is likely to mar or soil a wall by being pushed against it will be kept its distance by wood blocks mortised to receive the rear legs. Locate the mortise just far enough from the block end for needed clearance. Use no nails or screws.

When burners aren't level, an oil cook stove will not work well. Adjustable feet can be made for each corner from a carriage bolt and angle iron. Drill and tap the angle iron for the bolt or use a nut under it as well as on top. In the latter case, hold the bolt steady with a screwdriver and adjust the lower nut. The top nut is for locking.





Bedside-radio fans will like this hinged shelf that swings conveniently inward for turning a radio on or off or tuning the dial. It can then be pushed back out of the way. Besides providing firm construction, an endpiece keeps the radio from sliding off the shelf.

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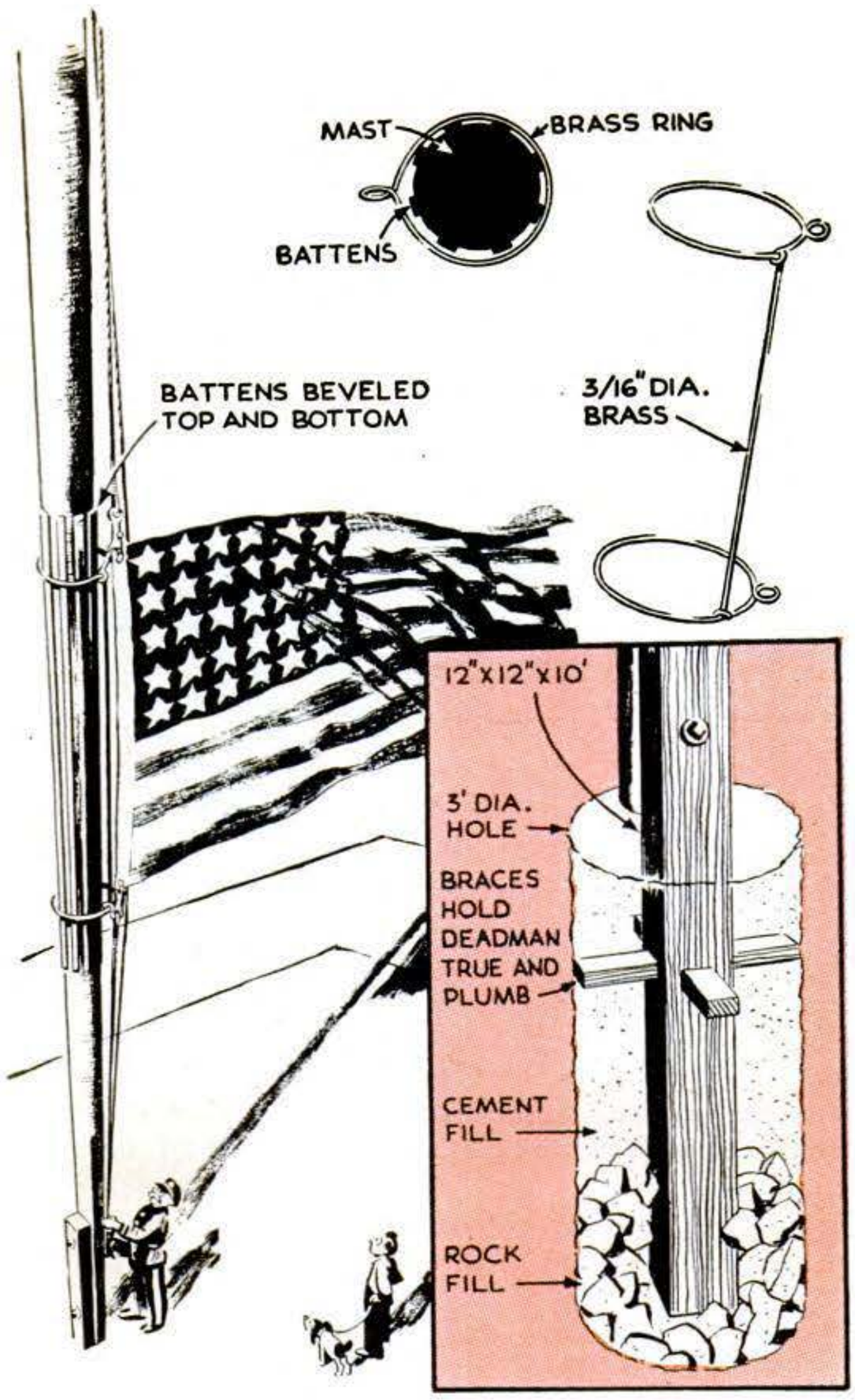


Two Hints That Will Help Keep a Flag Proudly Flying

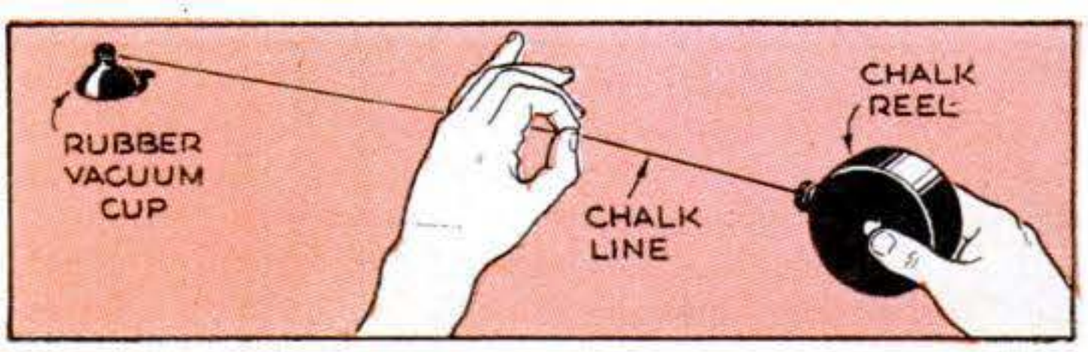
OLD GLORY always should be flown in a way that it will present the best possible appearance. Two ideas that will help achieve that end are illustrated at the left.

Observing that the wind frequently whips a flag at half mast with enough force to break the halyard, John E. Glover, Jr., designed a brass-ring support to keep it firmly against the pole. Battens tacked to the pole keep the paint and wood from being scarred by the rings. Between the rings is a rod long enough to equal the width of the flag, and snap fasteners on the halyard hook through the rings and the eyes in the corner of the flag. This system also will improve the appearance of a flag when it is flown at full mast.

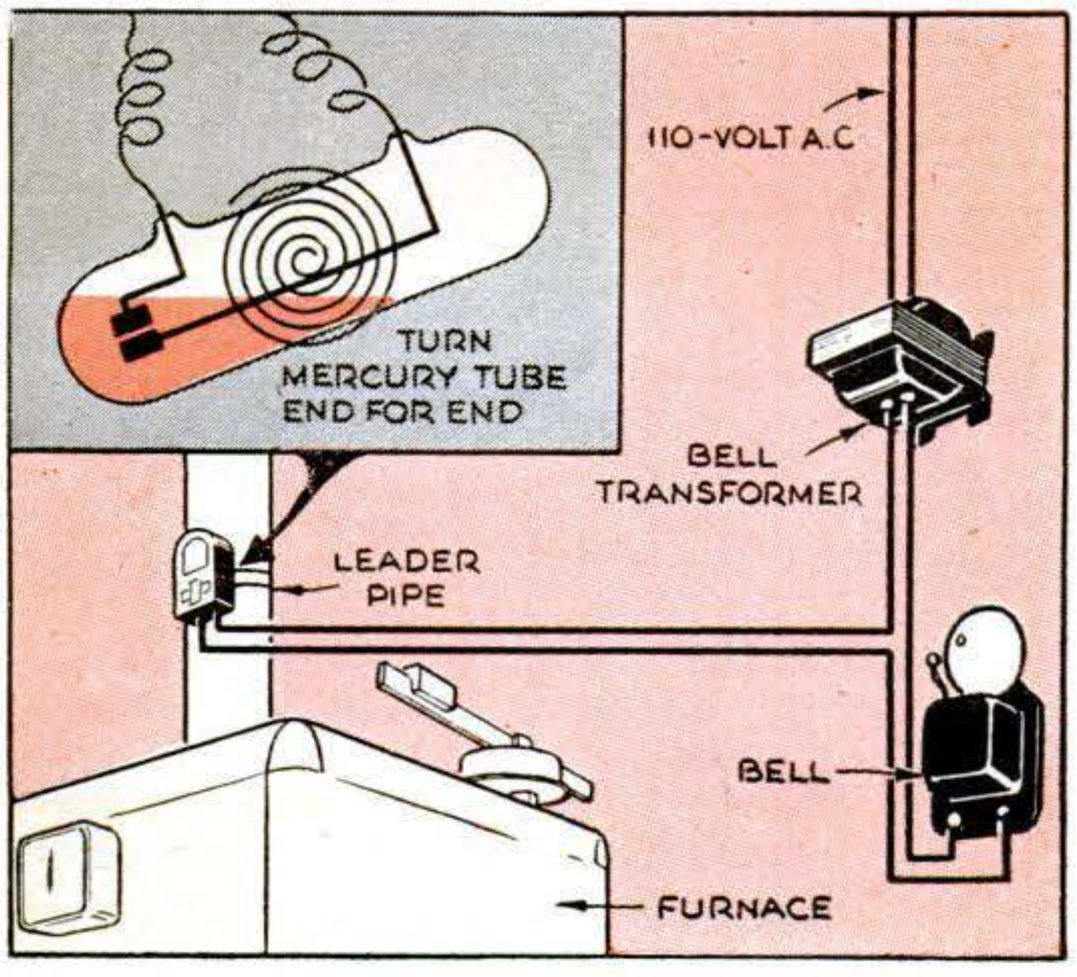
When a flagpole is to be erected, Harold R. Terpeny suggests bolting it to a deadman firmly anchored in concrete, as shown in the inset drawing, instead of merely setting the pole in a hole. The deadman usually is a piece of locust about 12" by 12" extending underground 5' or 6' and projecting slightly less above. In setting the deadman, be careful to get it plumb. Two sometimes are used, but one should be sufficient to support the ordinary pole.

Rubber Vacuum Cup Keeps End of Long Chalk Line in Place

WHILE I was laying off chalk lines on steel plates, the thought occurred to me that a rubber vacuum cup on one end of the cord would be a big help. As shown here, the idea was a success. The cup supports as much as 25' of line.—JOE B. HICKS.



Thermostat Rings Alarm Bell When Furnace Draft Is Left Open



BY REVERSING the action of a mercury thermostat and hooking it up with a transformer and doorbell, I now receive warning when it's time to close the furnace draft to keep the house from getting too warm. The system was rigged up after an old blower was removed, leaving the thermostat with nothing to do.

Ordinarily, the thermostat closed a circuit when the temperature in the furnace steam delivery or leader pipe fell below the point at which it was set. But when the mercury tube was detached and turned end for end, shifting the mercury contacts to the opposite side, the action was reversed; that is, a rise in temperature, rather than a fall, is required to cause the thermostat to close the circuit in which it is placed.—W. C. IRVING.

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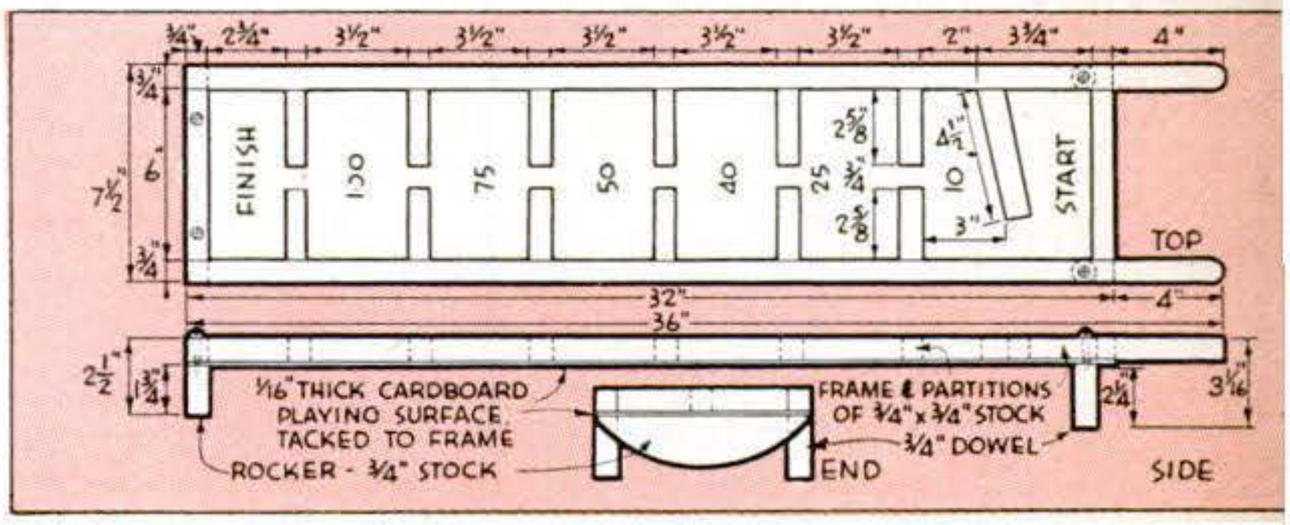
MARBLE DODGING RACE CALLS FOR A QUICK EYE

By Myron Fleishman

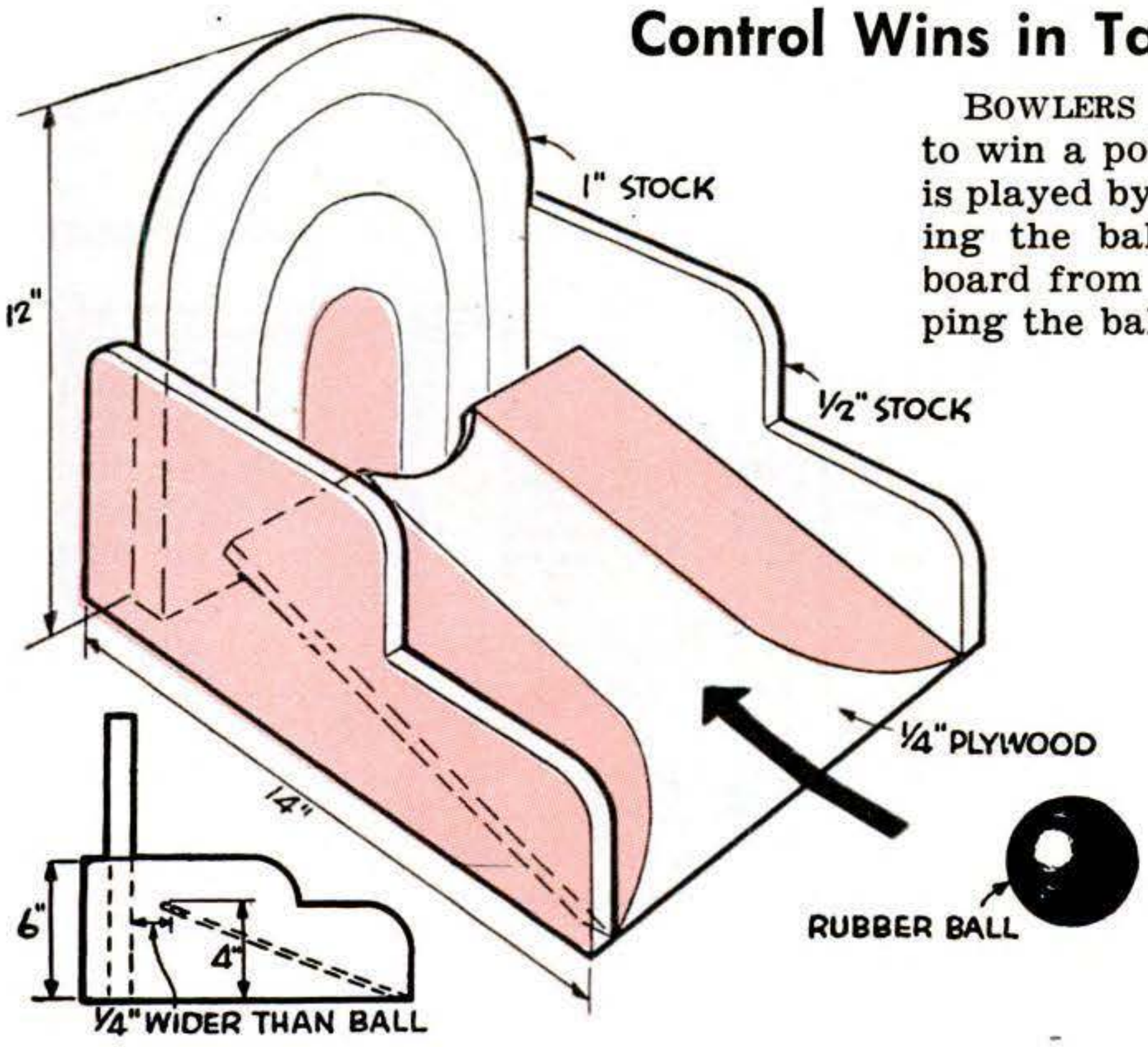
ORDINARILY the first contestant across the finish line wins a race. In this marble game, however, that rule has been thrown into the discard, and the first marble to finish wins absolutely nothing. Moreover, by the rules of the game, the lone marble bars all the others from further competition.

Ten marbles are used. The object is to get as many as possible in the high-point stalls before one sneaks through to the finish. The game is played by placing all the marbles in the section marked "start." The contestant then grabs the track by the handles, raises it slightly, and turns it back and forth on the rocker to get the marbles to roll through the narrow openings into spaces with progressively higher point value. Everyone naturally wants to guide as many marbles as possible into the 100-point stall. But that's a risky business, for just ahead lies the finish line. One slight error in judgment, and a marble may slip through.

When this happens the contestant must return the track to a stationary position immediately and tally his score. This is done by adding the numbers indicated by the marbles in the various sections, each marble being worth the number of points designated for that space. Each player completes a race in the same way. The player having the highest score wins.



Control Wins in Tantalizing Bowling Game



BOWLERS will have to employ all their skill to win a point in the game illustrated here. It is played by standing about 8′ away and throwing the ball so that it rolls up the inclined board from the floor. A point is won by dropping the ball through the slot at the top of the board.

Since the slot is only ¼″ wider than the diameter of the ball, a toss with exactly the right force is required to score. Throw the ball too hard—and it bounces from the back board. Throw it too gently—and it will not roll up the incline. Aiming toward the center, where the gap is wider, gives one a better chance.

By our rules, each player takes a turn, but anyone who scores may continue until he misses. First to score 15 points wins the game.—GUTHRIE B. STONE.

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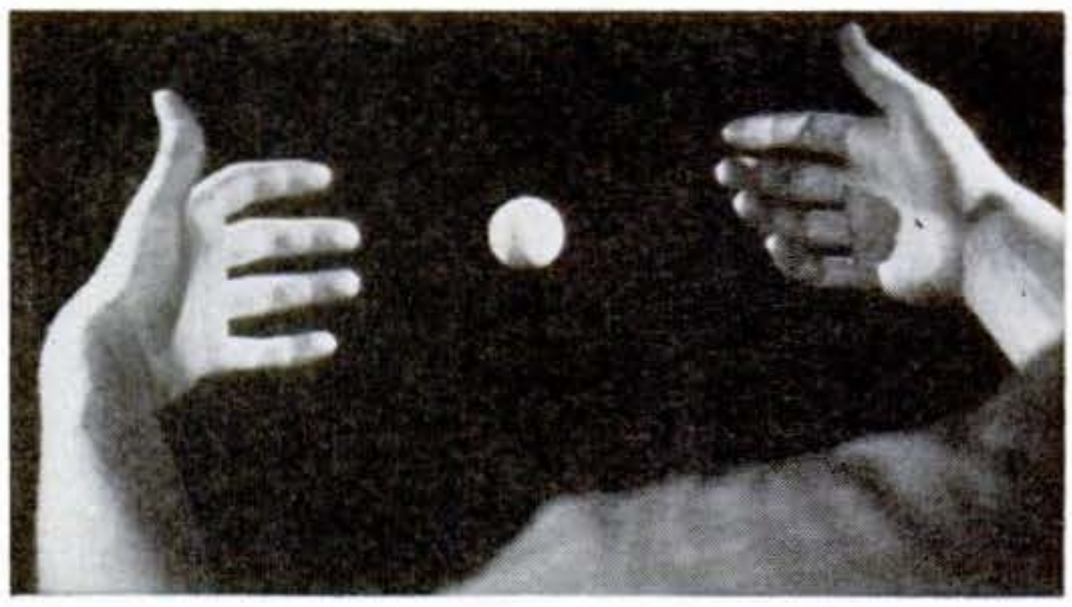
TABLE TRICKS

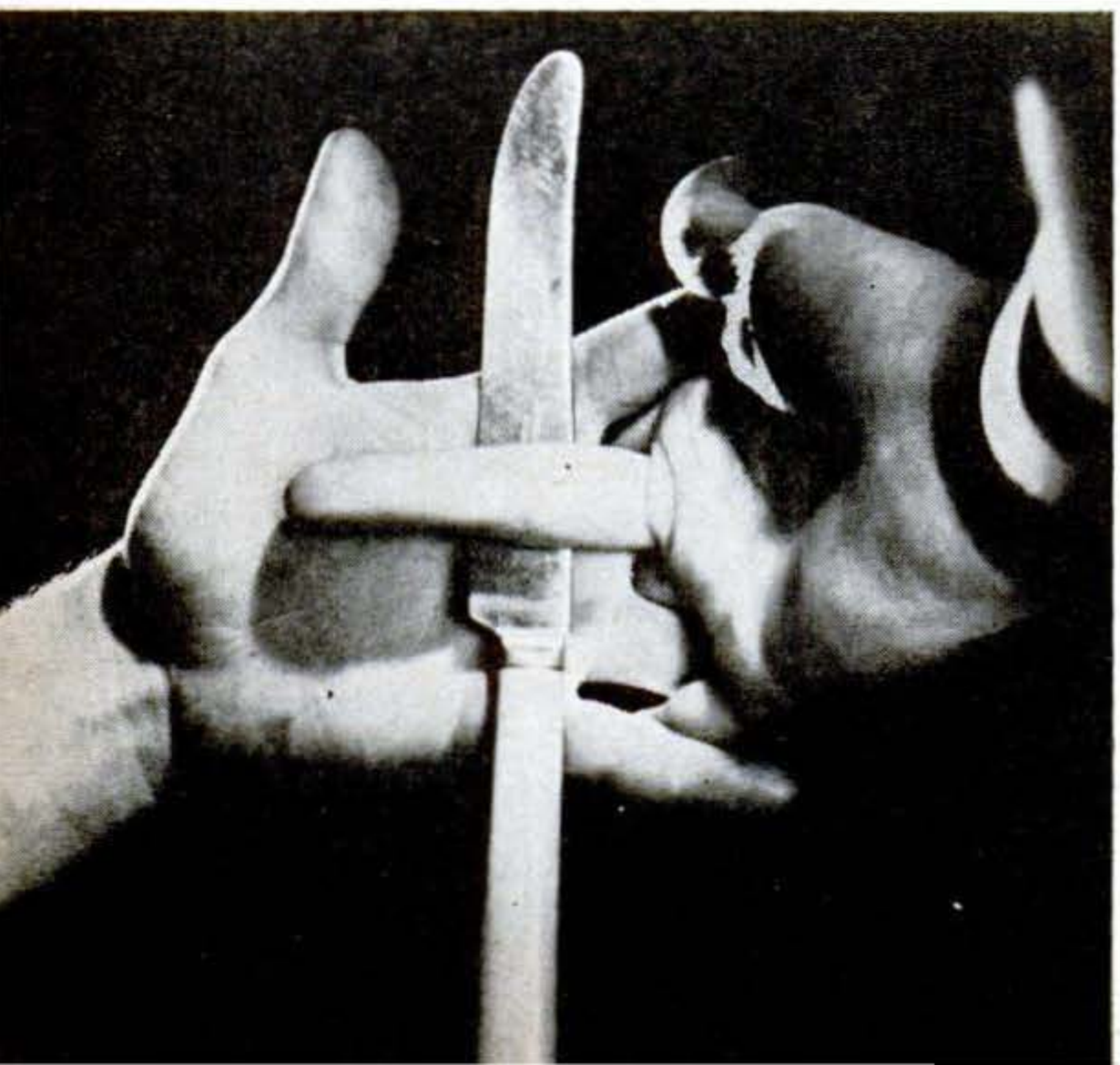
TWO ON A MATCH is no stunt, but simultaneously lighting two cigarettes 5′ apart with one paper match takes some know-how. Secretly split the end first. Strike the match, let it burn a moment, and pull the split end apart to make two burning matches. Then light the two cigarettes.

HYPNOTIZING A BALL will enable you to move it through space, make it stop, retreat, and return again. If will power alone isn't strong enough to make a table-tennis ball behave, loop a track of black thread over one finger of each hand. Remember, hypnotism of this sort needs a dark background.

UP AND AT HIM. The eager pencil jumps out of your hand as you present it to an unsuspecting friend. It doesn't really do so of its own accord, though. A rubber band, looped inconspicuously around your second finger and under the end of the pencil, pops it out when you unclench your fist. Push the pencil deep into your fist to stretch the rubber for the needed tension, and be careful not to point the pencil at anyone.



A "MAGNETIC" KNIFE sticks to your palms as you show the backs of your interlaced fingers to your audience. At first you keep your thumbs out of sight, whereupon your loudest critics claim these are supporting the knife. Bringing up the thumbs, as shown at the right below, you confound these hasty guessers. Your right middle finger actually supports the knife as at the left below; it isn't missed if you interlace the other seven properly. Finally, drop the knife and show that your hands are empty.



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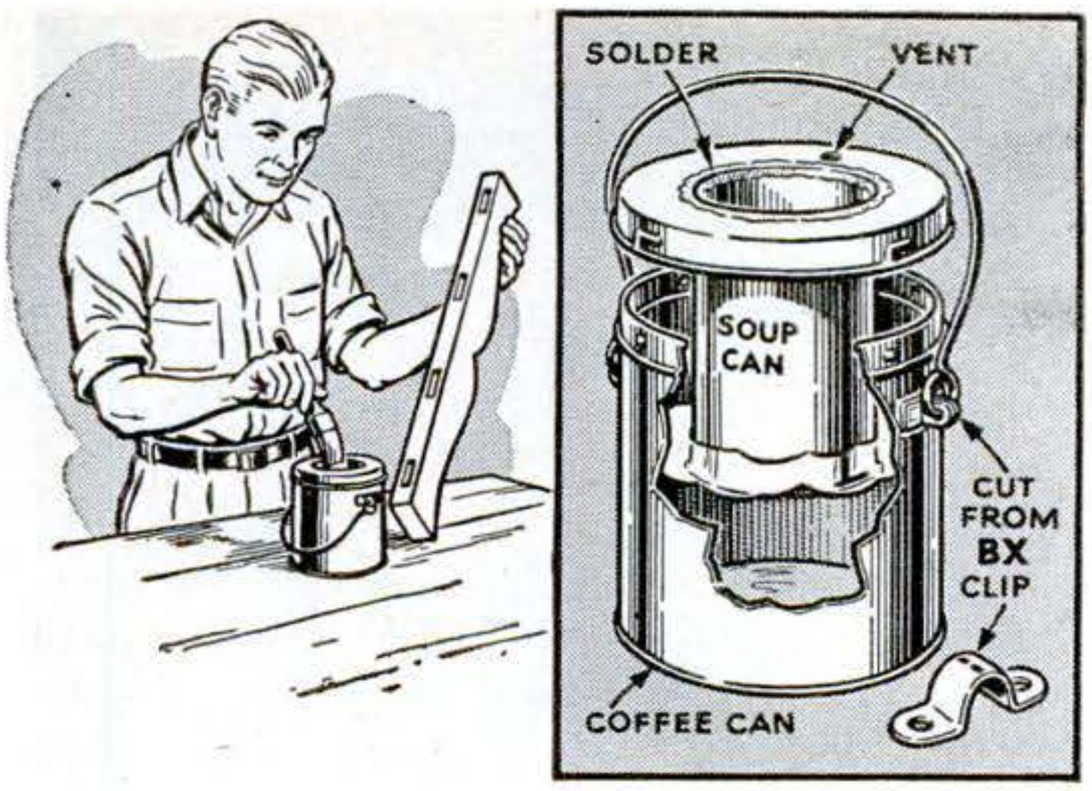
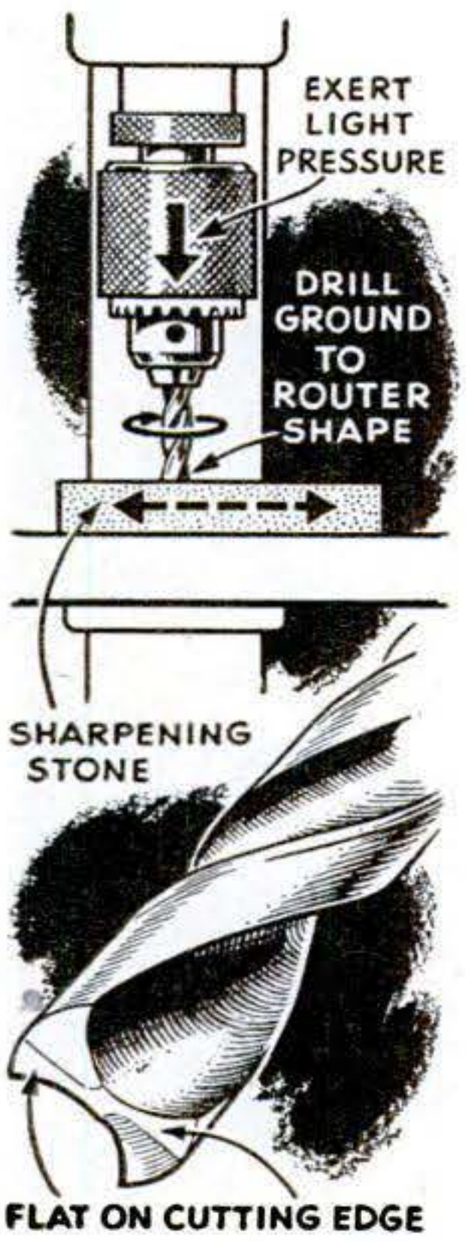


Double-Boiler Glue Pot Built from a Pair of Tin Cans

NEEDING a quantity of hot animal glue, I made a double-boiler type of glue pot from two cans of different sizes. Hot water in the outer can keeps the glue hot sufficiently long so that a gluing job can be done almost anywhere in the shop or home.

A 1-lb. coffee can was used outside, and a small soup can was soldered to a hole cut in the cover of the first. A small hole punched in the cover permits escape of steam generated when the water bath surrounding the small can is heated. Ears made by cutting a BX-cable clip in half were soldered to the sides of the coffee can and a bail was added.—JOSEPH F. BAZATA.

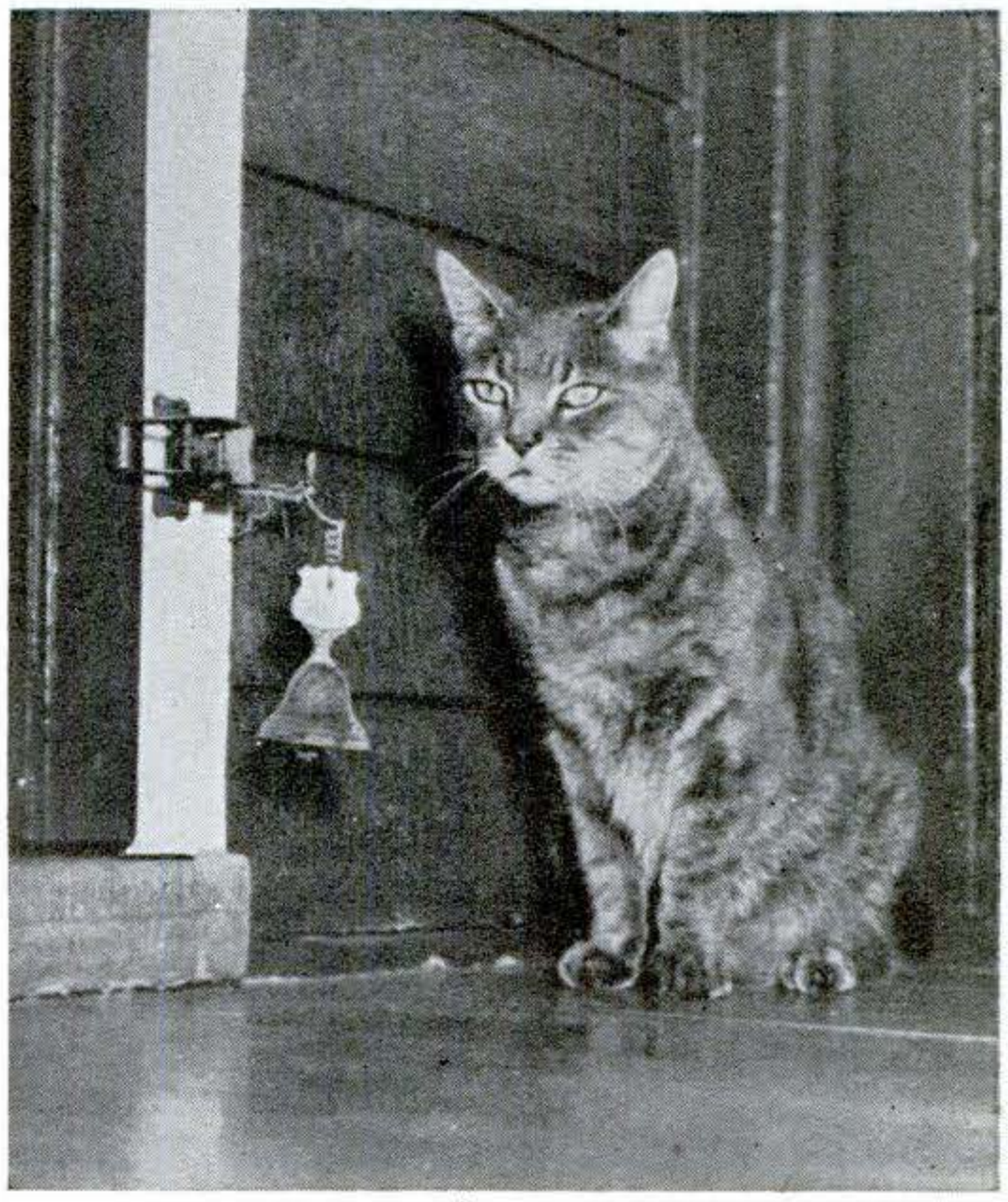
Router Improvised from Drill Leaves a Smooth Surface

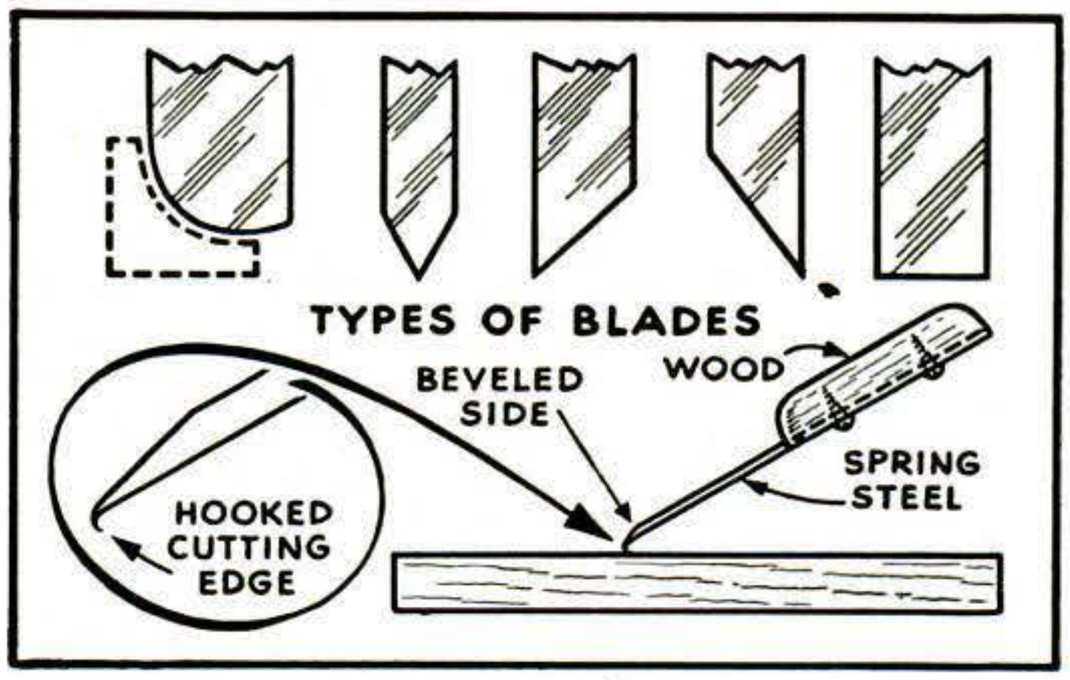


WHEN you need a router bit in a hurry, you can press an old drill into service with good results. First, grind the tip to an ordinary router shape. Then, and this is the secret of a smooth surface, put it in the drill press, exert light pressure, and work it at medium speed over a sharpening stone until a very small flat is produced on the lips. In use, chuck the router as short as possible to lessen side spring. Although intended primarily for wood, such a router works equally well on plastic for shallow cuts.—H. R. P.

Belling the Cat Takes New Turn

UNLESS you can teach your cat new tricks, this idea is likely to prove a dud. It was a success, however, in the case of August J. Goran, of Williamsville, N. Y. His cat swats the bell as a signal that it's tired of wandering and wants to enter the house. Then it waits for someone to come to the door.





Spring Steel Used for Scrapers

WOODWORKERS who need scraper blades of various shapes for use on carvings and other intricate work may make their own from scraps of spring steel. After grinding the steel to the desired shape, sharpen it to a razor edge on a fine stone, being careful to keep the bevel on one side only. Then grasp the scraper blade firmly and force the cutting edge against a piece of hard steel in such a way that the edge is curled away from the bevel of the blade.—G. S. GADDA.

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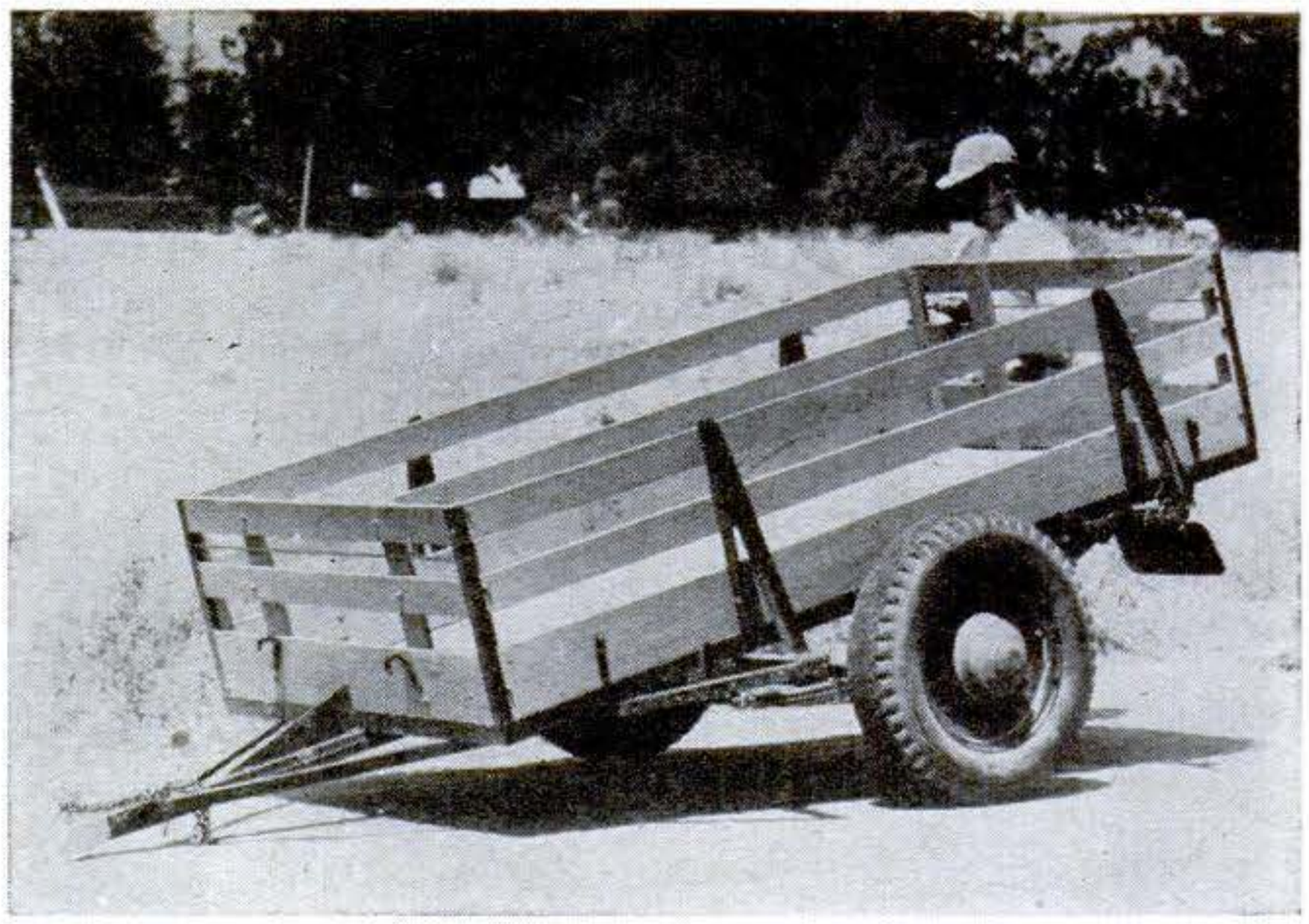
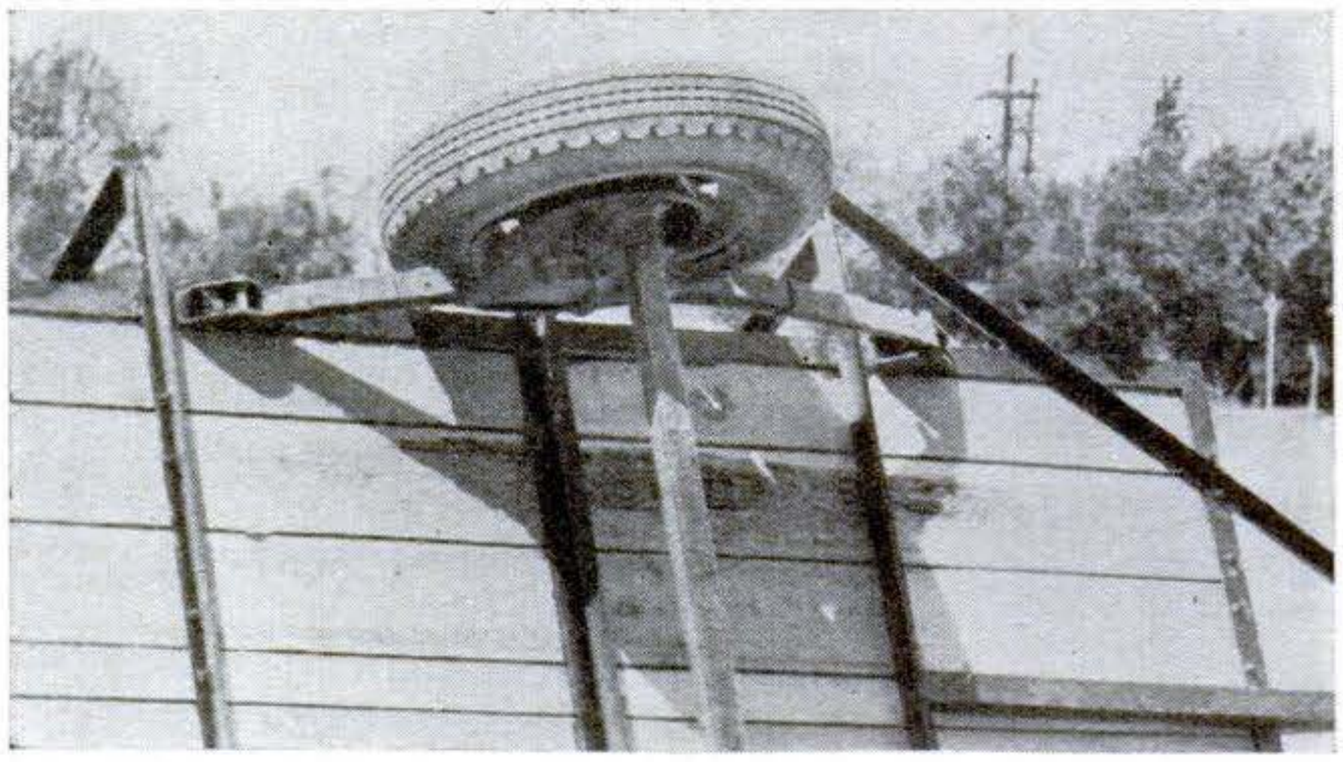
Auto Trailer Carries Heaviest Load in Full Safety at High Speed



Quickly hitched to a car, this homebuilt trailer can be used for many hauling jobs. Hangers welded to the frame hold the springs.

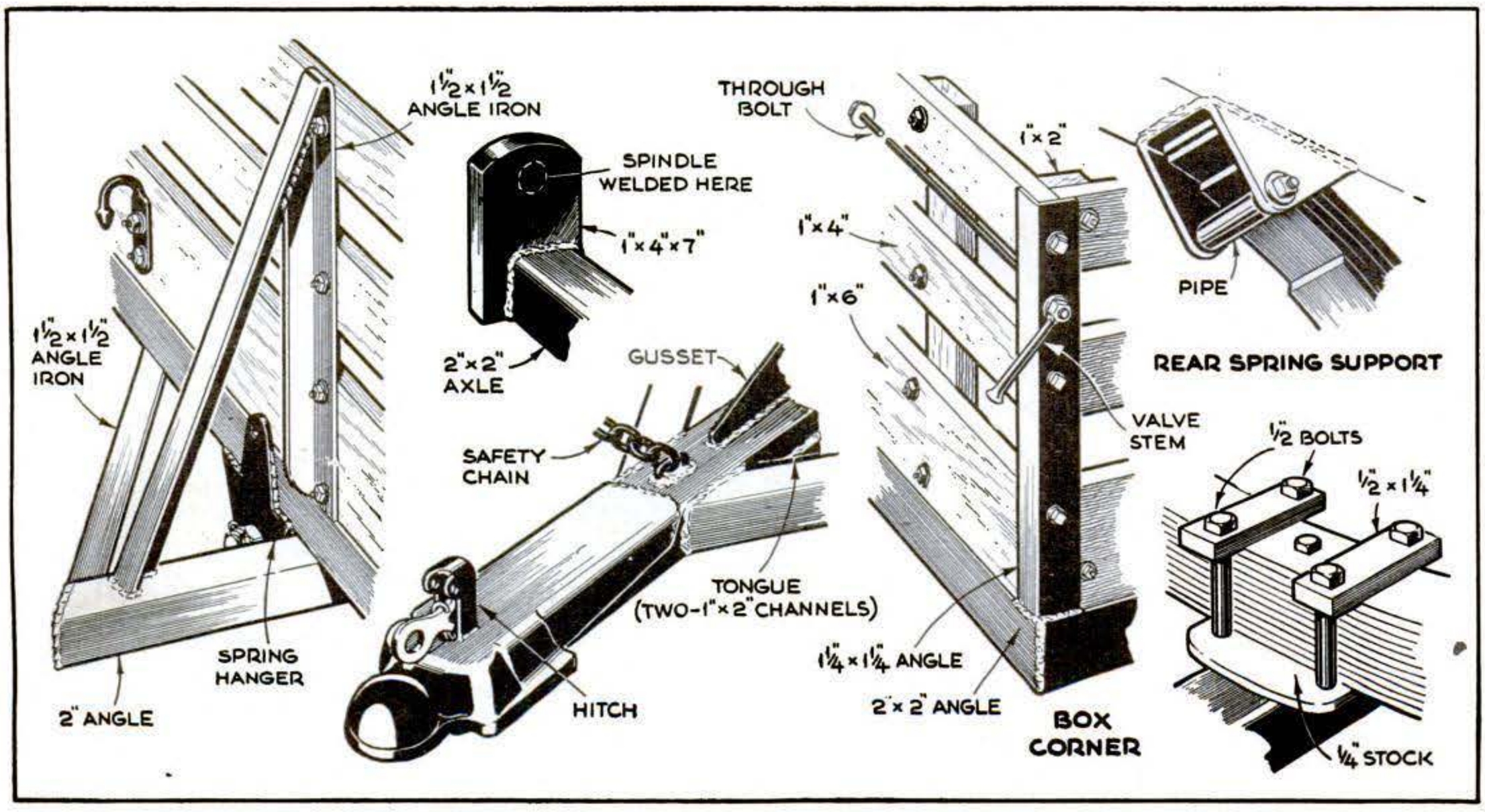


STURDILY built, this auto trailer tracks smoothly with heavy loads even at speeds in excess of 60 m.p.h., stability being assured in large measure by the method of wheel and spring mounting that was employed.

The frame consists mostly of angle iron. Two 1″ by 2″ channels welded together provided the 2″ by 2″ tongue. Tongue braces cross under the front corners of the frame, to which they are welded, and project beyond the wheels, forming shielding bumpers. Triangular braces stiffen the sides.

Spindles were welded to offset plates, as shown in the drawing, dropping the axle well below center. No shackles were employed in mounting the springs, the forward eyes being bolted directly to their hangers and the rear ends entering above the bolts, where, heavily greased, they slide against the hangers as the springs flex. In the original, the springs were bolted to a plate welded to the axle, but U-bolts around the axle might be employed instead.

The box body is 22″ by 48½″ by 96″, the wood members being attached to the metal frame with carriage bolts and lag screws. Through bolts across the ends give greater rigidity to the body.—E. M. L.



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Doom on the Wing

(Continued from page 88)

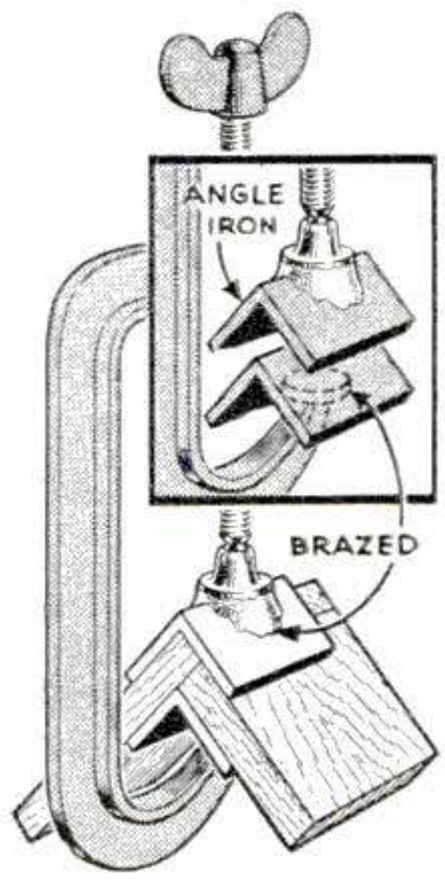
cently that when we can increase the thrust of such missiles, we literally can get "out of this world" into space beyond the pull of the earth's gravity. This would be an epochal scientific achievement.

Countermeasures against these high-flying missiles and air-launched types that operate closer to the earth's surface are being studied with the same urgency that we are applying to our advanced pilotless aircraft, rockets, and bombs. New paint and camouflage techniques will be used to foil the light-sensitive missiles; the defenders may have to use these new finishes on even their own guided missiles. Radar countermeasures, such as the "electronic razzberry" or window dispensing, will be applied against the "Bats," RHBs and SRB missiles. A super-degaussing device may be used as a defense against the magnetism seeker, and various lighting tricks will be played on the launchers of light seekers. "Hot" countermissiles may be launched to decoy away and destroy heat seekers.

The offensive group will, of course, seek to counter the countermeasures—all of which may result in a War of the Worlds which seems utterly fantastic. Shortly before his resignation as chief of the AAF, General H. H. Arnold stated: "If defenses which can cope even with such a 3,000-mile-per-hour projectile (as our V-2) are developed, we must be ready to launch such projectiles near the target to give them a shorter time of flight and make them harder to destroy. We must be ready to launch them from unexpected directions. This can be done by true space ships, capable of operating outside the earth's atmosphere. The design of such a ship is all but practicable today; research will unquestionably bring it into being within the foreseeable future."

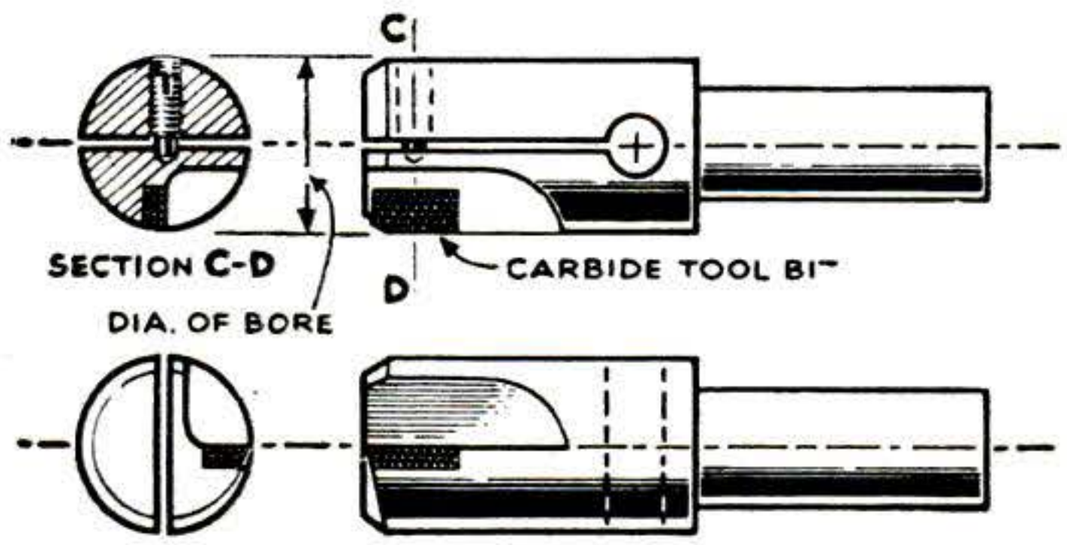
But who is going to accomplish this research? Even the Buck Rogers boys are having their little "jurisdictional disputes." The air and ordnance branches of the Army and Navy are both involved in missile making. Problems of procurement and production supervision also have been encountered. Weapons which are self-propelled or launched from the air or have aerodynamic characteristics are being put under the cognizance of the AAF and BuAer, while those which are fired from the ground or depend on charge propulsion are being turned over to Army Ordnance and BuOrd. More clearly defined policy will probably result from the creation of the new Joint Guided Missile Committee.

Angles on Clamp Line Up Corners



Two short lengths of 1" angle iron brazed to a C-clamp, as shown at left, provide a means for clamping right-angle joints. Mitered wood corners can thus be clamped for gluing, butt joints can be held in alignment for nailing, and metal corners can be supported for riveting or welding. Take care in brazing not to let molten metal get in the ball socket and destroy the free action of the moving jaw.—G. S.

Tool Bores Cored Hole to Size



Shop owners doing production work will find the tool shown above very useful for precision boring of cored holes in castings. The body may be made of cold-rolled steel and casehardened. An expansion slot and a screw permit adjustment for wear and sharpening of the carbide tip, which is brazed on in the usual way. The shank is turned to fit into the tailstock ram, turret head, or other tool-holding device.—U. G. D.

"Looking for me, Pop?"

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A Nut in the Model Garage

(Continued from page 144)

ly and so cause weaving and other varieties of shimmy. Only new front-wheel bearings will cure the trouble. Now let's try to find out what's causing the squeaks and groans."

He got an oil gun and thoroughly sprayed all the little pieces of leather fixed between the fenders and the body and along the frame where the body was fitted on it. Then he checked all the spring leaves and the action of the shock absorbers.

'Everything seems O.K.," he told Stan, "but I'd better take a little ride."

He was back in five minutes. "Still noisy," he said. "Now let's see—" He was interrupted by a tremendous knocking on the office door. "Better let them in."

Stan opened the door, and the two customers hurried into the shop, the sandy-haired man carrying a box that obviously contained clams.

"Got my car fixed?" he asked.

Gus told him about the worn front-wheel bearings.

"You'll have to let us have your bus for a day if you want us to install new ones," he added. "And so far I haven't been able to locate the source of the squeaking you complain about."

The portly man looked pityingly at his companion. "Does he mean that slight noise which you so foolishly have allowed to disturb your tranquility?" he asked. "Why, I located the cause of that the other day, but I forgot to tell you."

He lifted the hood and pointed to the lacing near the radiator. "There it is."

"By gum, he's right!" Gus exclaimed. "The lacing has been worn flat and pushed out of position so it doesn't support the hood, and that causes the squeaks. It's a frequent cause of squeaks, but one that is difficult to locate."

"I didn't find it so," the portly man said calmly. "Just a simple process of elimination."

"We'll install a new lacing when you bring the car in," Gus told him.

The sandy-haired man nodded and slipped behind the wheel, and his companion got in beside him. "Home, Coleman," he said.

"Yes, Dunbar—we're late," the sandy-haired man replied.

They drove out of the shop.

"Say, boss," Stan asked, "which *is* the crazy one?"

"Well," Gus said, "I figured it probably was the big one—until he found the cause of that squeak after I'd missed it. Now I don't know. Maybe it's me!"

How to Hunt Uranium

(Continued from page 123)

mic rays. This would make it necessary to correct the "background count."

Night prospecting may play an important part in the search for uranium. Carnotite and pitchblende do not respond to ultraviolet light, but many other uranium materials do; they glow in beautiful fluorescent colors. A sizable deposit of uranium starts the Geiger counter clicking frantically, but if this occurred in a mine, it would be impossible to tell whether the rays were coming from above, below, or to the side. In this case the ultraviolet lamp should be flashed across the rock face. It may outline the minerals in their characteristic yellow or greenish glow. At night, this method may also be used in open country. In the daytime, samples may be placed inside a viewing box and studied nearly as effectively through an inspection hood.

Many substances besides minerals glow under ultraviolet light. Scorpions, horned toads, lizards, and snakes fluoresce gold or cream. Fossil teeth, bones, and shells are likely to glow, as well as petrified wood. Watch these closely, for carnotite and other radioactive substances sometimes are carried in solution, eventually landing in sandstone or other porous substances. Petrified logs heavily impregnated with carnotite have been discovered. In Colorado, two such logs yielded 100 tons of ore containing nearly two grams of radium, plus enough uranium and vanadium to pay the lucky discoverer nearly $250,000.

These substances may glow by their own natural luminescence. Fossilized deer's antlers, glowing weirdly in the darkness, led one prospector to a deposit of carnotite, while rat's teeth and moose jawbones, mineralized with radioactive salts, have told their own story of riches.

A specimen of radioactive mineral, placed on a strip of film, will often make a self-portrait, the masses of radioactive elements standing out in the picture from the inert rock surrounding them. If a key or coin is placed between the rock and the film, and a long exposure made, a shadow picture resembling an X ray may be discovered when the film is developed.

Chemical analysis for uranium is tedious, but modern prospectors generally have spectrographic assays made, which cost about $6 each. Since such a test reveals not only uranium but any other minerals present, the possibility of unsuspected riches has made the method not only popular but in many cases mighty profitable.

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The living-room car will have deep carpeting, comfortable lounge chairs that can be moved, built-in radios, and full-view windows. For the children, the Junior Club car will provide a slide, marionette show, miniature piano, writing desks, a blackboard, books, and many other playroom facilities. The club-cinema car combines a bar lounge, which can be converted into a night club with space for dancing, and an observation lounge that can be turned into a movie theater.

For low-cost, all-coach trains, there will be "Day-Nite" cars with seats that provide leg rests to give passengers full-length body support when they want to sleep. Latest developments in sleeping-car design include a three-tier sleeper with accommodations for 42 passengers, and a "duplex-roomette" that will provide private washing facilities and a made-up bed for approximately the cost of a lower berth.

Invisible Rays Guard Milk Cans

A NEW U-shape ultraviolet lamp that in one minute kills 96 out of 100 bacteria in washed milk cans has been developed by the Westinghouse Lamp Division Research Laboratories. The 30-inch-long lamp fits into any conventional-size dairy utensil, spraying invisible ultraviolet rays to all exposed areas. Operating on standard 110-120-volt, alternating-current circuits, it consumes less electricity than a 25-watt electric light bulb.

Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

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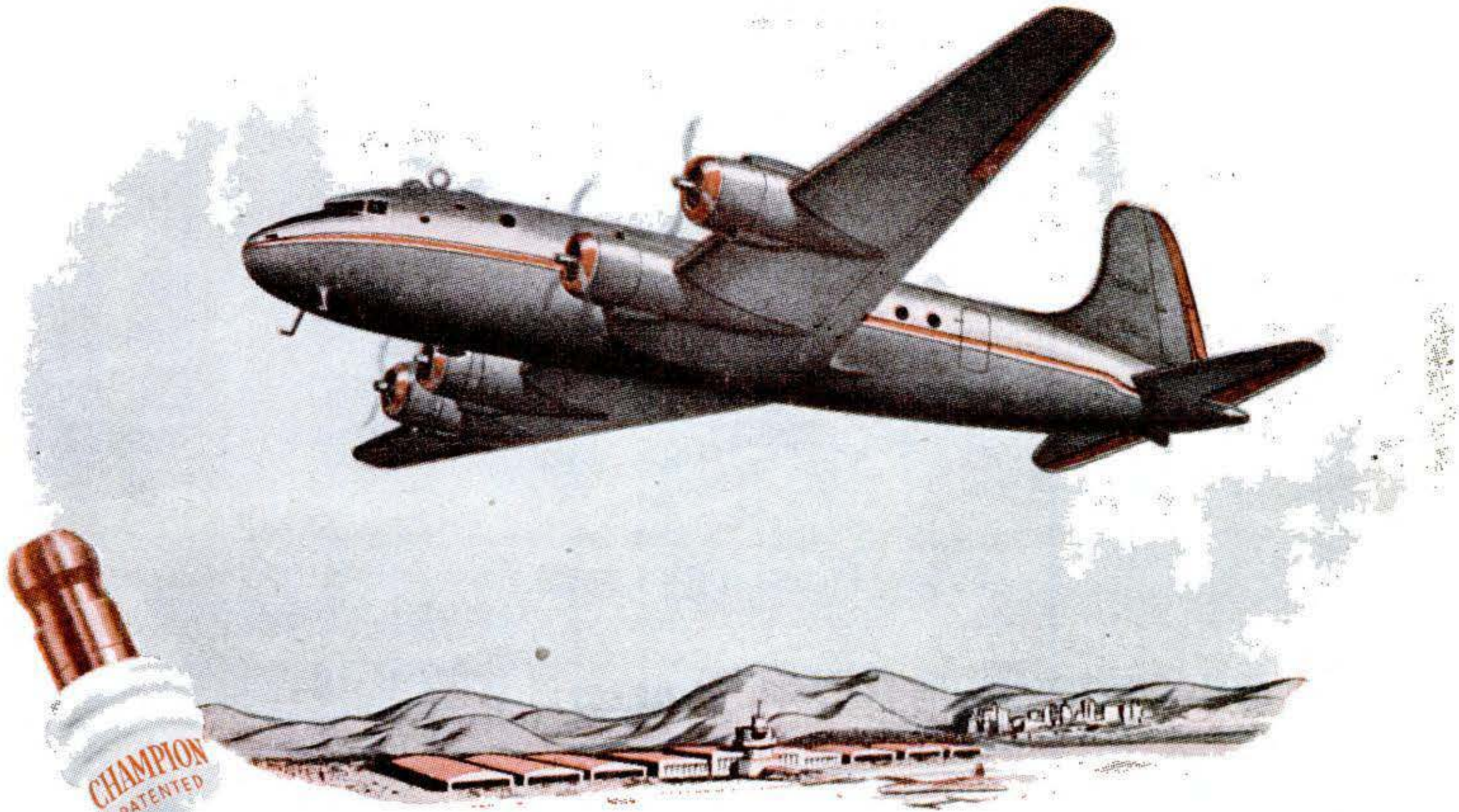

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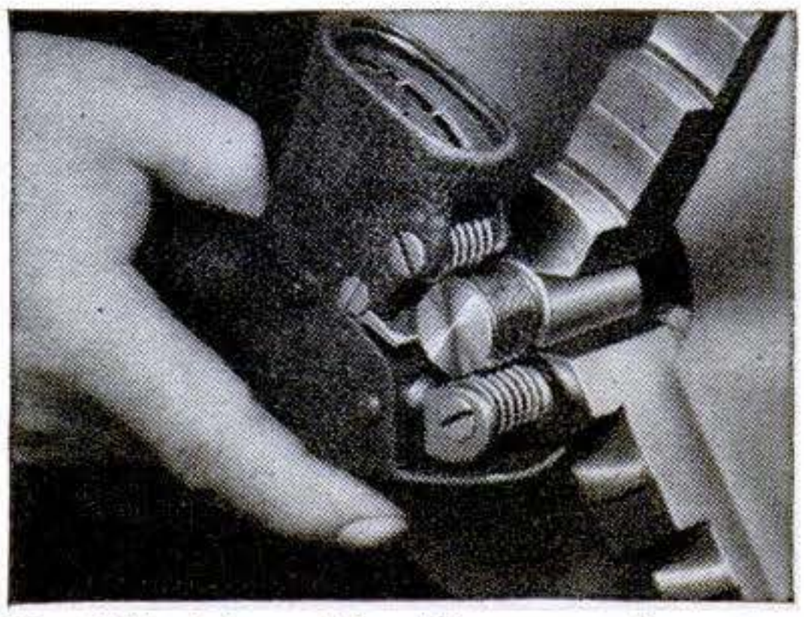
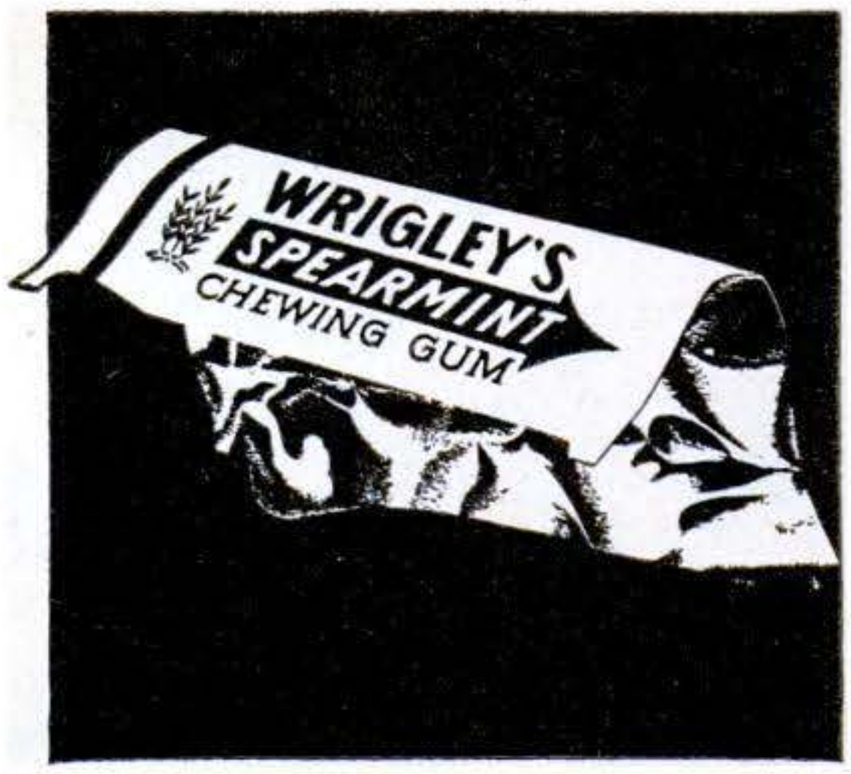


Hand Model used for "in process" gaging



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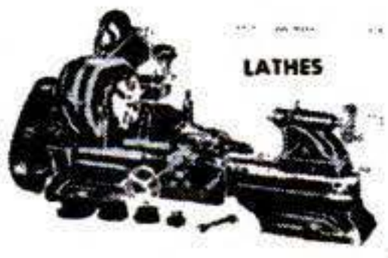
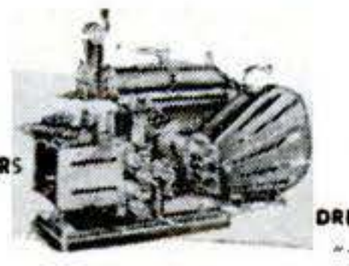
Atlas 4 TOOL TEAM





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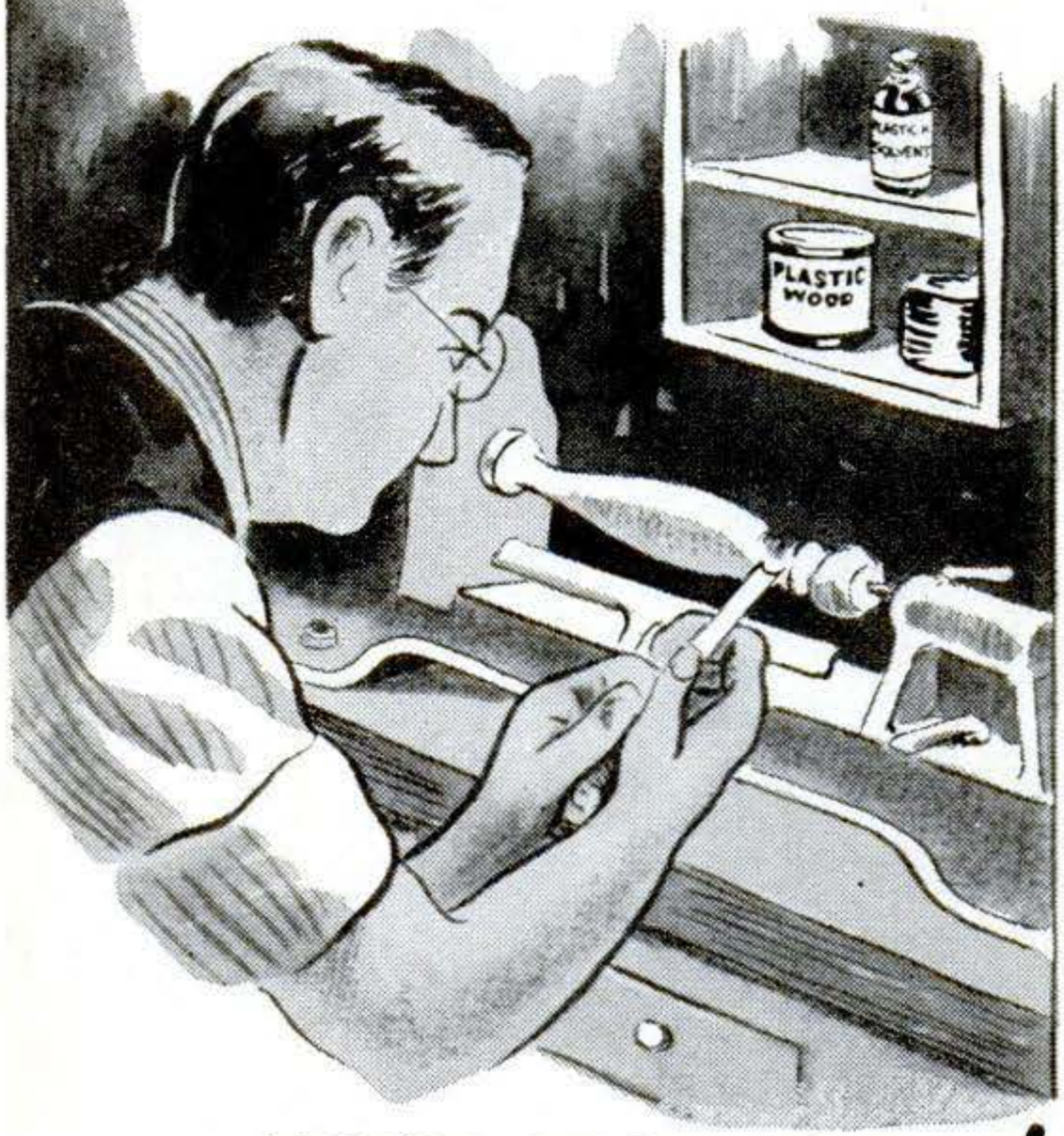

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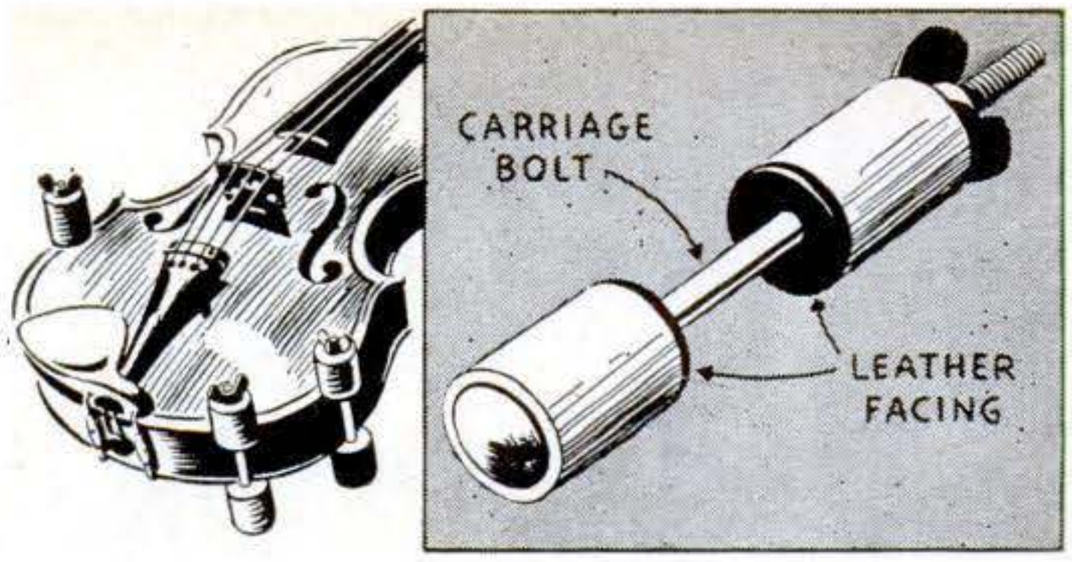
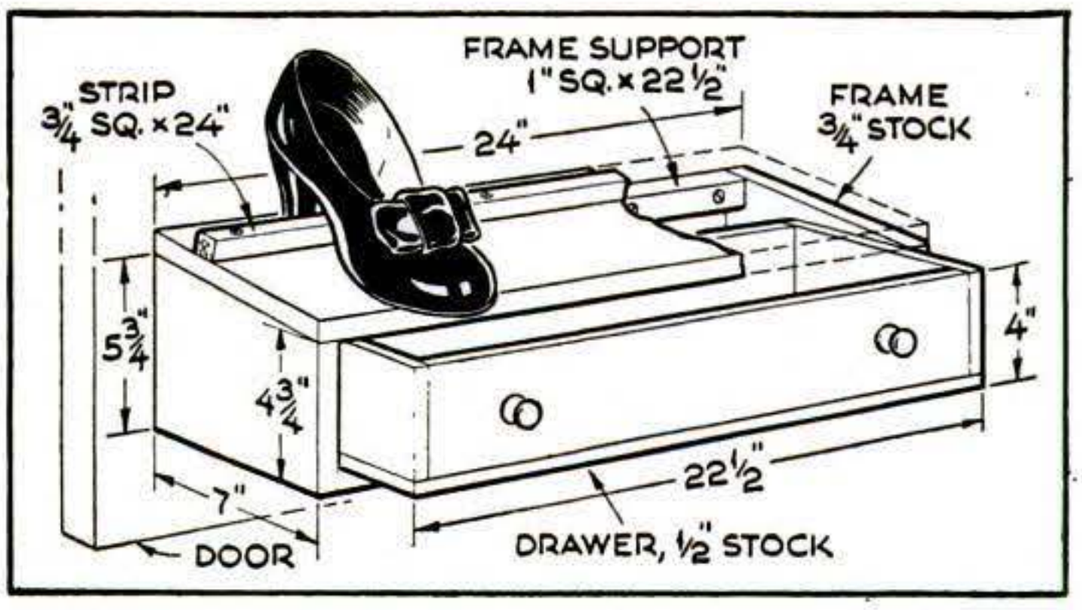


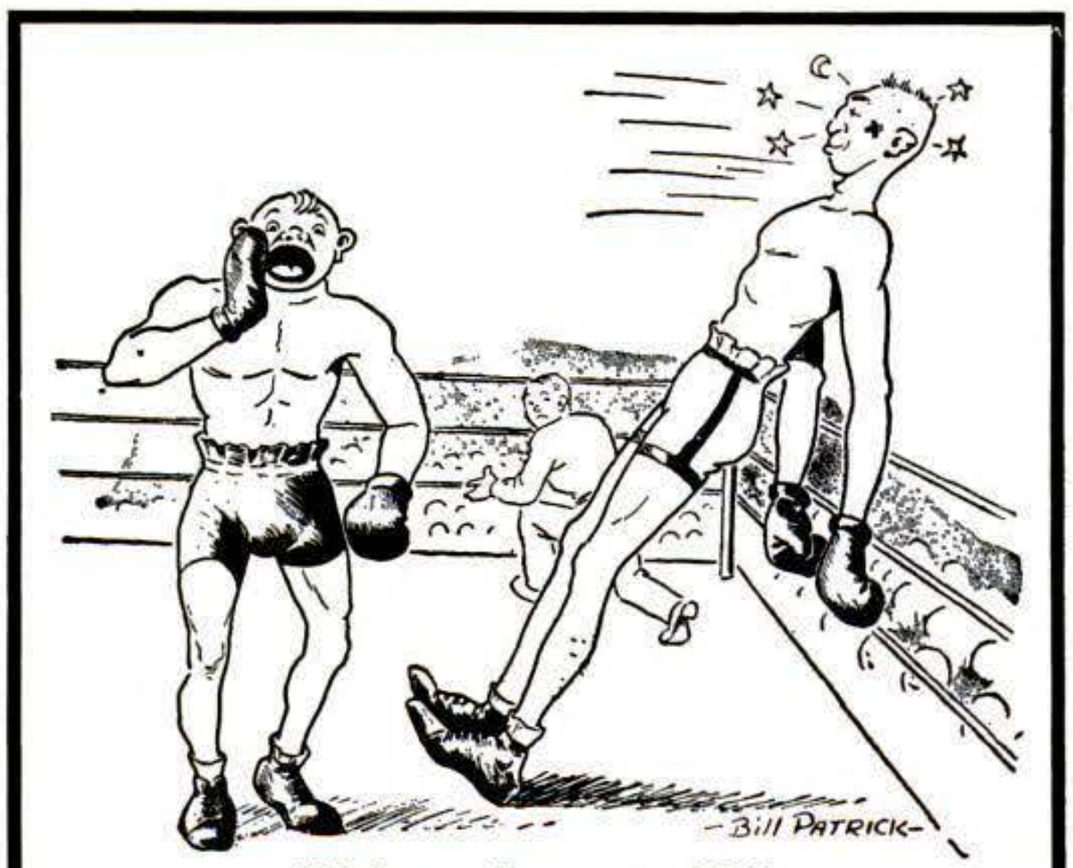
Dowels on Bolts Clamp Violin

STANDARD ¼" carriage bolts and wing nuts used with hardwood-dowel jaws drilled for a sliding fit make clamps for holding violin bellies and backs in place. A leather facing glued to each jaw will prevent marring of the varnish.—RICHARD P. MILBURN.



Shoe Rack Inside Closet Door Has Drawer for Shine Kit

MATERIALS for keeping your shoes shined will be near the shoes in the drawer of this closet-door rack. The top of the piece slants down toward the front, and a wood strip near the back holds the heels of the shoes. Screw the piece to the inside of the door through the frame support at the back before nailing on the top. Drawer pulls may be turned or purchased ready-made. Paint to match the door.—E. W.



"T-i-m—b-e-r-r-r!!!"

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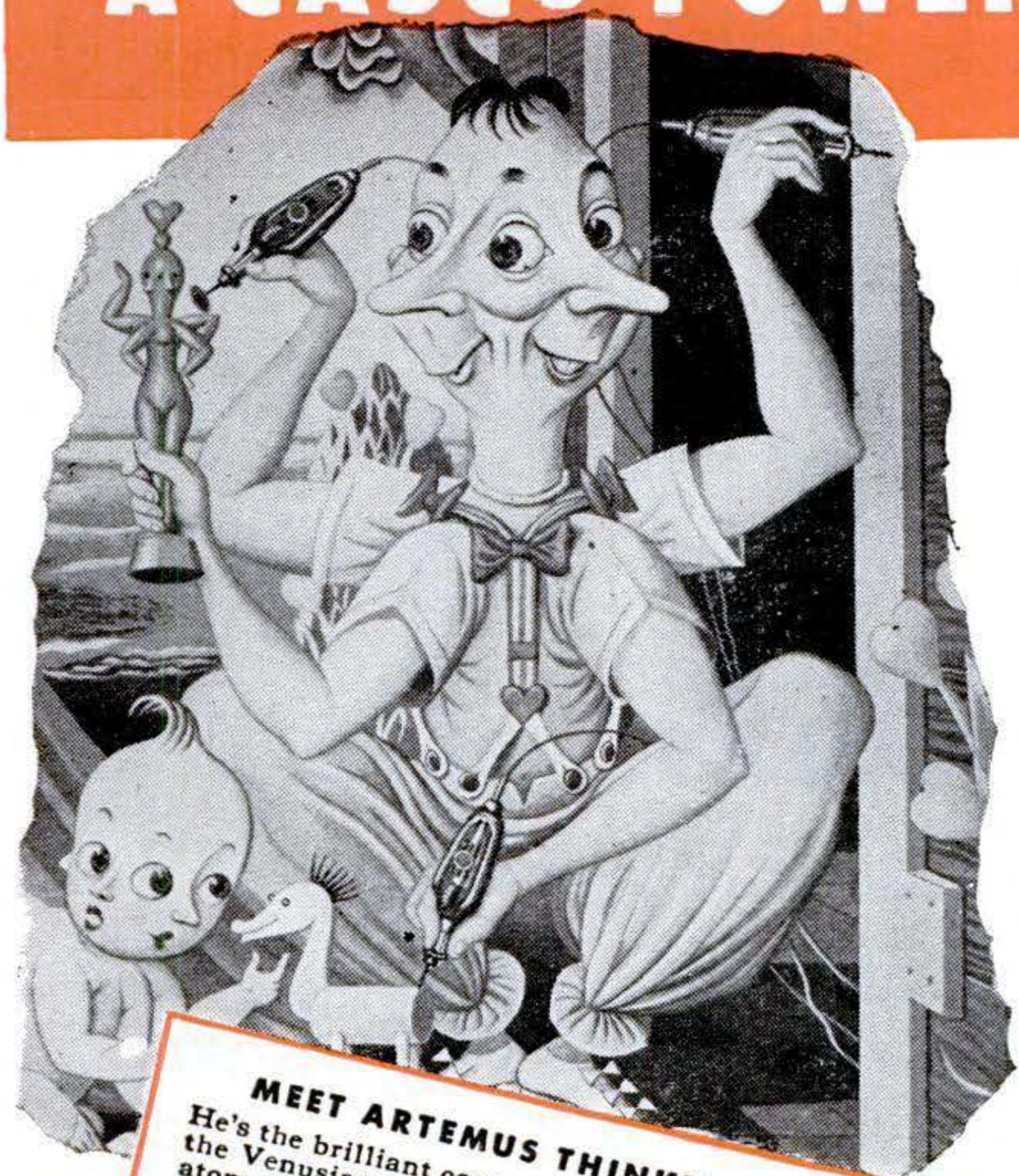
SEE WHAT YOU CAN DO WITH A CASCO POWER TOOL KIT



MEET ARTEMUS THINKLE OF VENUS

He's the brilliant concept of artist Boris Artzybasheff—the Venusian you'll meet and like as soon as the new atom-drive space ship is completed. Mr. Thinkle's four hands (notice they're all right hands) give him a slight edge—but you can do everything he's doing with a Casco Power Tool Kit—and more!

- ***It's hand-sized—handles as easily as a fountain pen!***
- ***Gets into small places—does fine detail work***
- ***Works on metal, glass, wood or plastic***
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- Sanding
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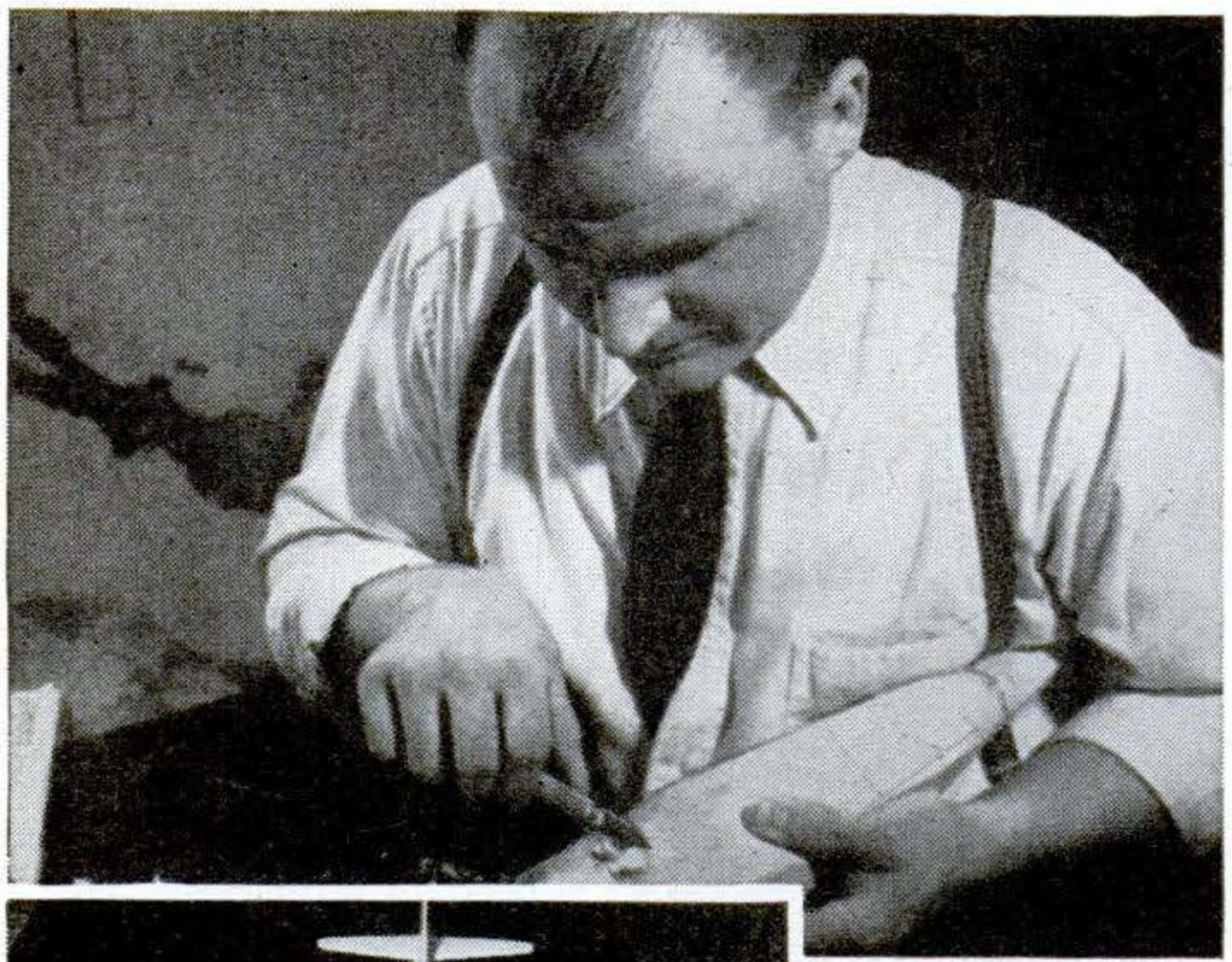
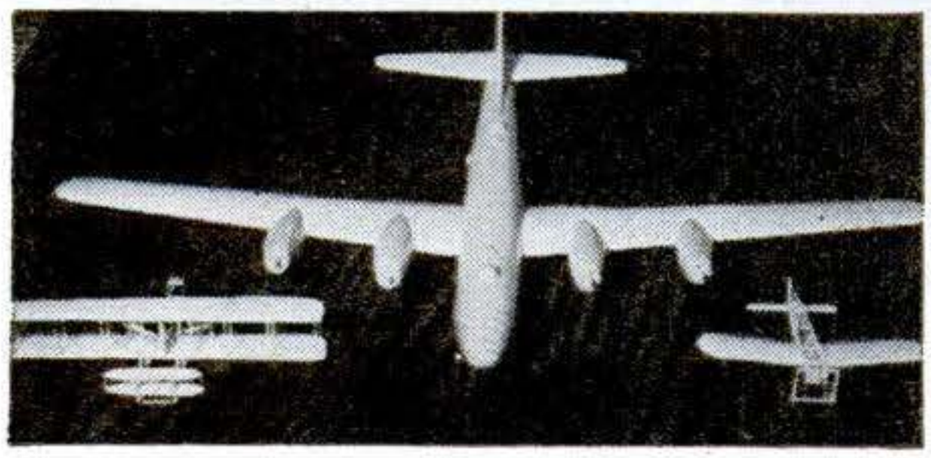
Planes That Made History!





Above: Adolph Esbrandt of Baltimore carving a miniature Boeing Clipper.

Left: Esbrandt's scale models of the Wright Brothers' first plane; the first plane to fly across the English Channel; the famous B-29.

Baltimore Hobbycrafter Builds Scale Models of Famous Planes—With X-acto Knives

SAYS X-ACTO IS INDISPENSABLE

Not everybody who likes to build scale model planes can be as expert at it as Adolph Esbrandt. But you'll come a lot closer to it if you use the knife the experts choose . . . a super-sharp X-acto!

"I find X-acto indispensable," says Mr. Esbrandt. "With its variety of blades and handles, it's the perfect tool for *every* job from tiny braces to the big, solid fuselage section."

What's Your Hobby? Plane models? Whittling? Leather work? Photography? Get yourself an X-acto and you'll have a lot more fun. Easy to use as a pencil, keen as a surgeon's scalpel. It's the hobbycrafter's favorite knife for paper, wood or plastics.

Girls, Too? Sure thing! Plenty of girls make plane models . . . and use X-acto Knife kits. Send 10c for a copy of "How to Build Scale Model Planes," an illustrated, 32-page booklet that tells you just what to do.

X-acto*

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ONLY X-ACTO KNIVES HAVE ALL THESE IMPORTANT ADVANTAGES

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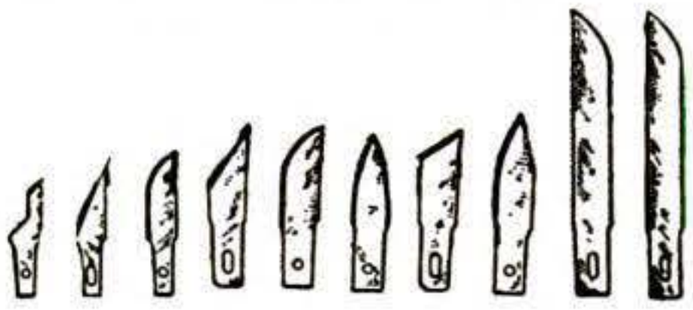
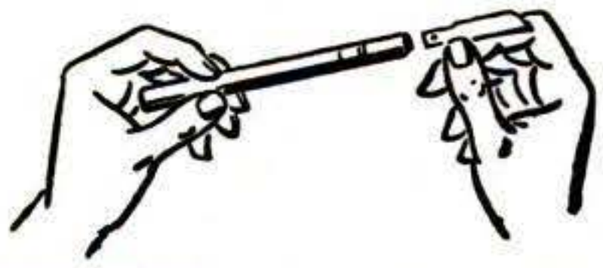


10 BLADE SHAPES, interchangeable. All of scalpel-sharp surgical steel. A blade for every type of cutting job.

3 HANDLE STYLES, of solid duraluminum construction. Designed for safety, firm grip, precise control.

INGENIOUS COLLET DEVICE locks in blades securely, so they can't fold under on curves or heavy cuts.



CHANGE BLADES in about 5 seconds. A twist, a twirl, and there! X-acto's always sharp, always ready.

X-ACTO TOOLS, TOO! Scientifically accurate, each perfect for its purpose. Sander, 50c; Balsa Stripper (without Knife), $1; Planer, $1. Drill Holder and Pin Vise, 75c; Hobbycrafter's Saw, $1.25.

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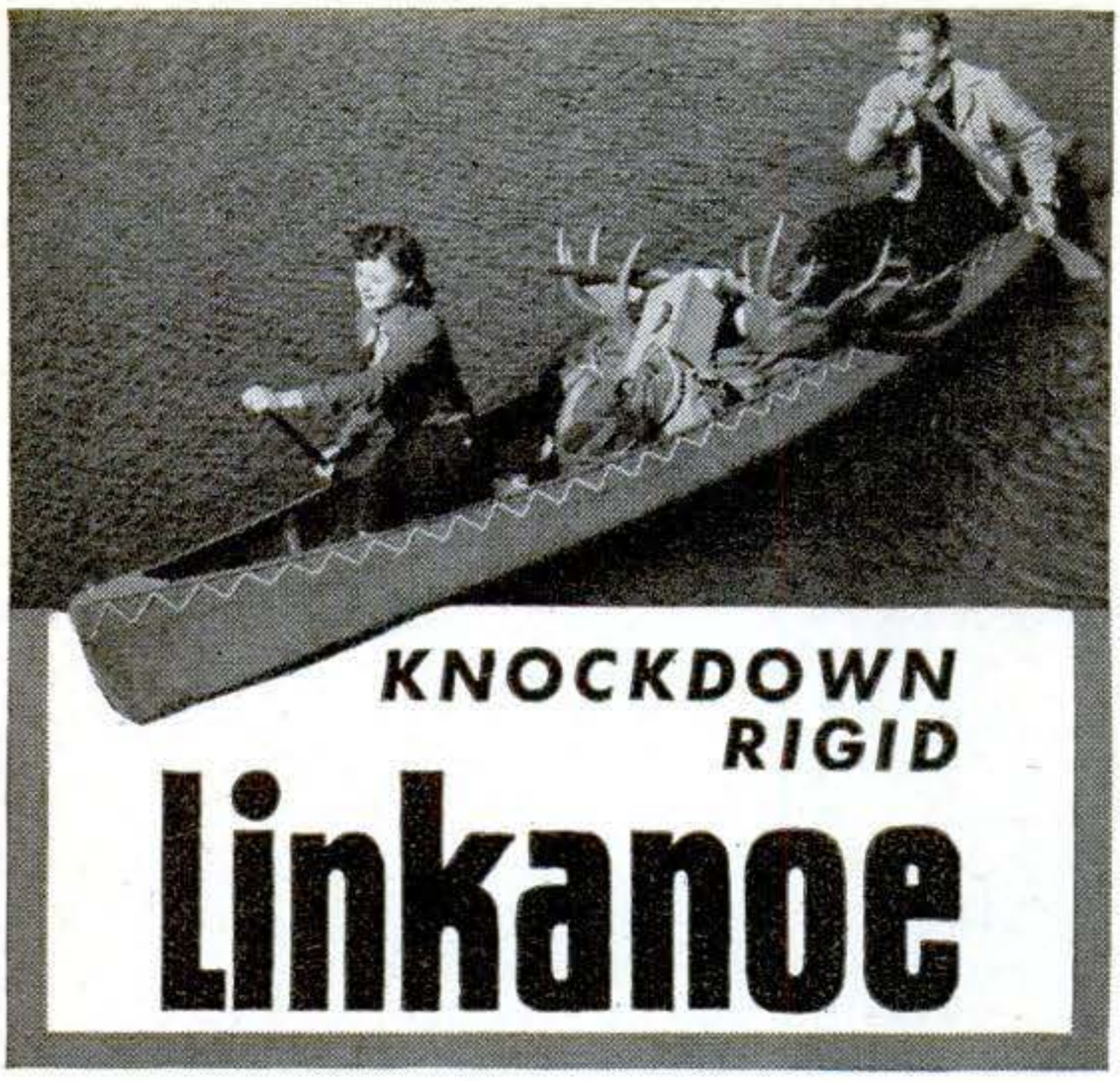
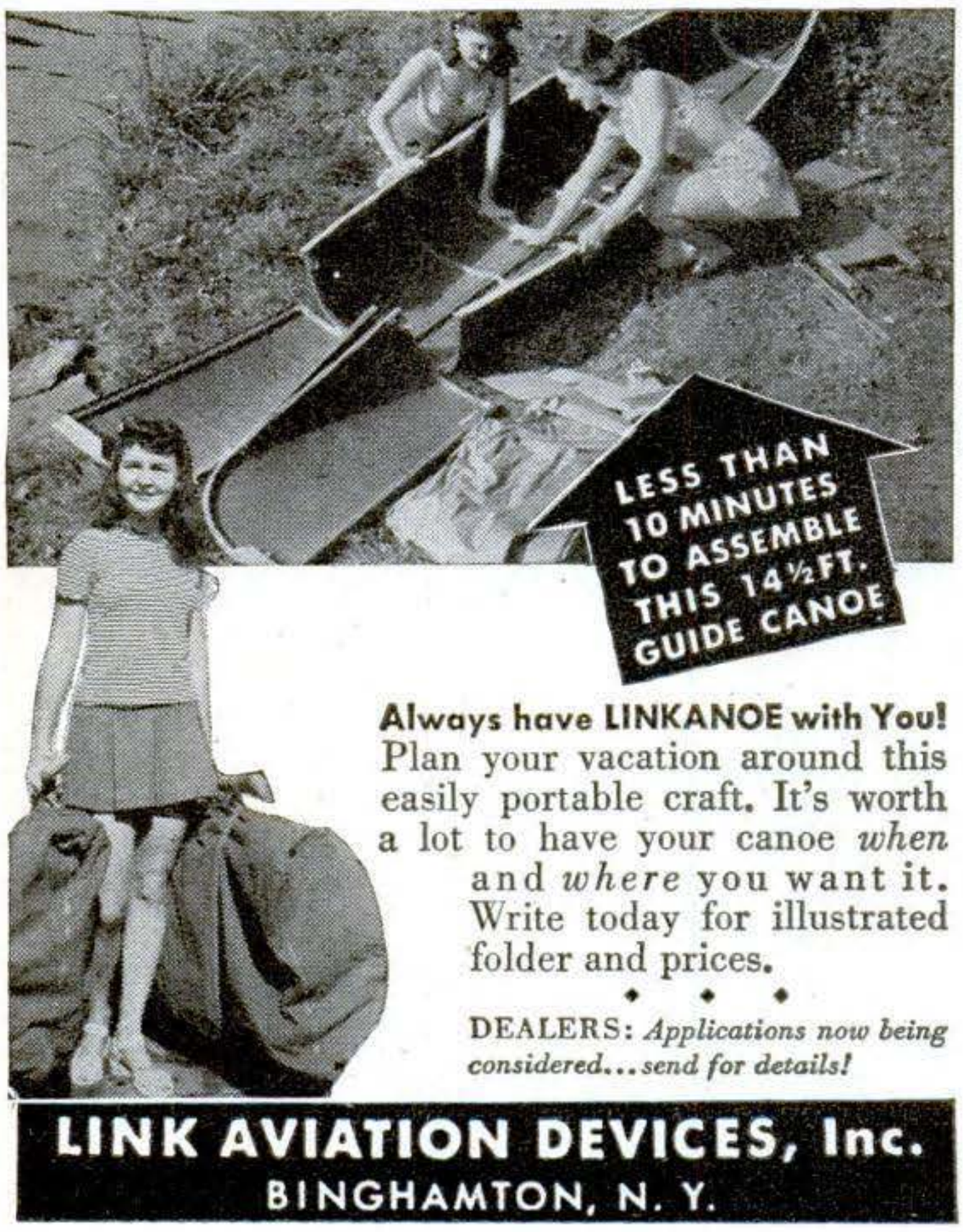


The NEW sectional canoe

Take it along on *every* trip! Made of lifetime plastic, the Linkanoe assembles in less than 10 minutes. Strong moulded sections clamp rigidly together...no tools needed.

LINKANOE is built by the makers of the famous Link Trainer. Designed by sportsmen who fly into the North Country, carrying their craft by plane. Under rigorous tests, Linkanoe has proved sturdy, superbly balanced, easy to handle. Packs into two, easy-to-carry bags. Goes in luggage compartment of car, by plane or pack horse.



Always have LINKANOE with You! Plan your vacation around this easily portable craft. It's worth a lot to have your canoe *when* and *where* you want it. Write today for illustrated folder and prices.

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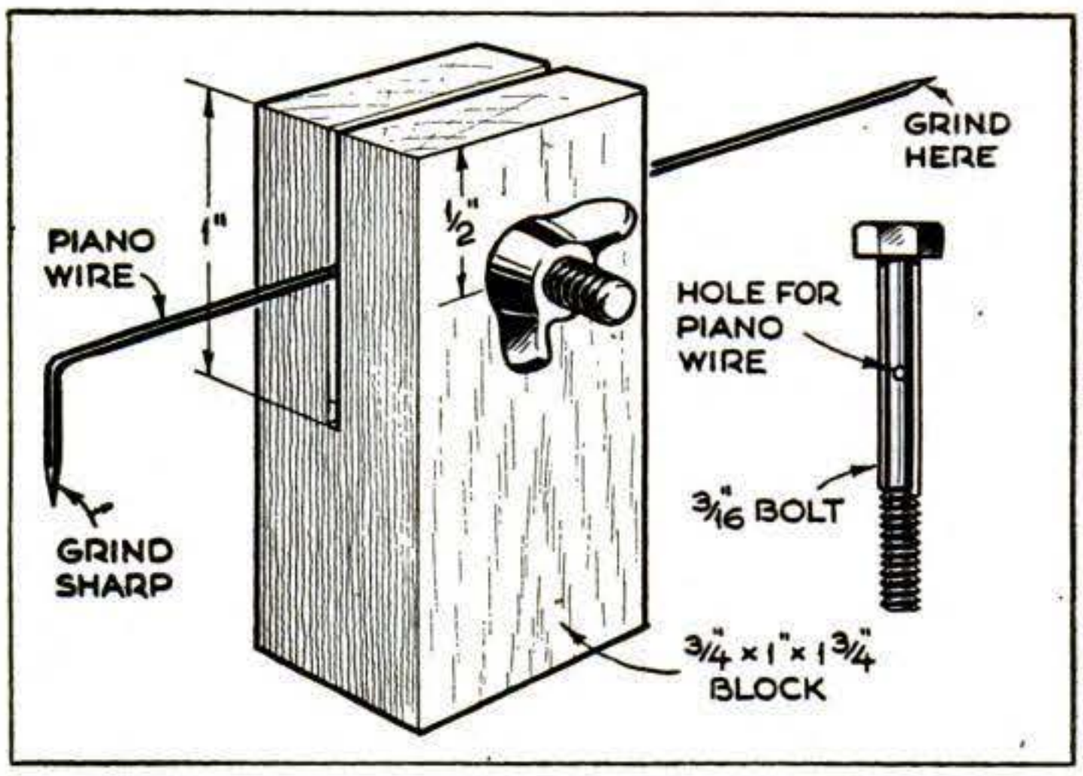
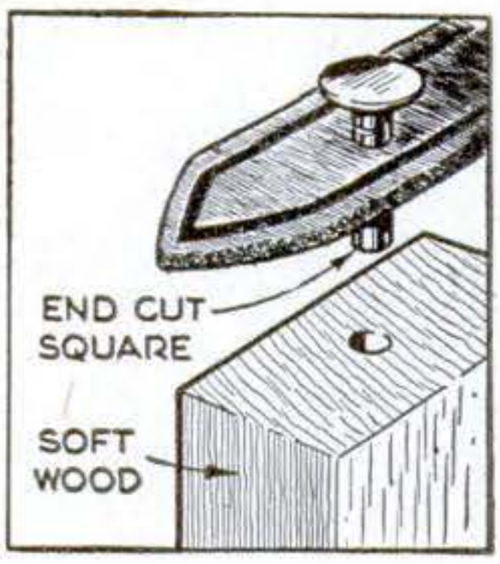


Scratch Gauge Made in Few Minutes

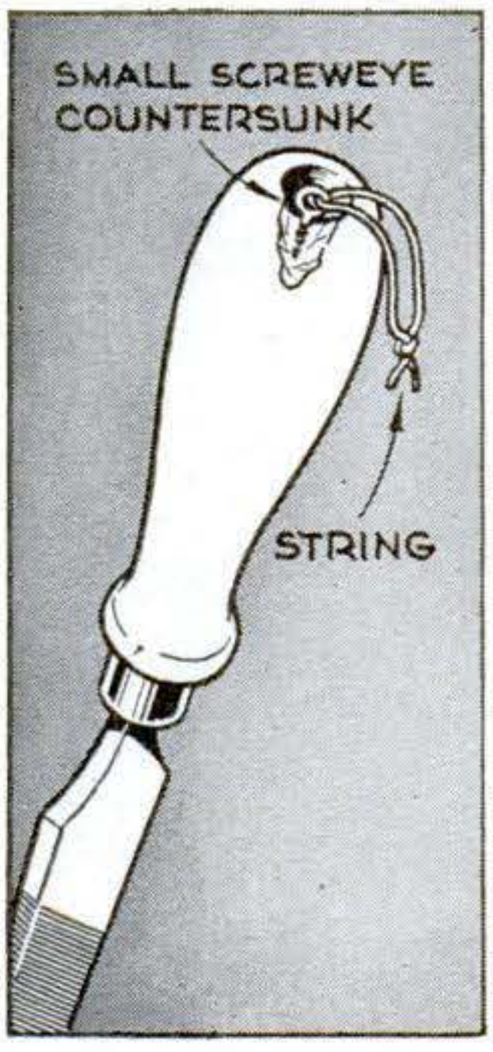
THIS scratch gauge and edge scriber was produced by drilling a 3/16" hole and cutting a slot in a hardwood block, and then inserting the bolt and marking it where it passes through the slot. A hole for the wire was drilled in the bolt at that point.—W. H. M.

Square-Cut Nail Serves as Punch



WITH the end filed off perfectly square, a wire nail serves as an excellent substitute for a leather punch. Select a nail the size of the hole desired and drive it through the leather into the end grain of a block of soft wood. The idea also will work on many other materials, including light metals. In the latter case, a hardwood block should be used.—FRED W. CARTER.

Screw Eye Countersunk in File Handle



HAVING a handled file that was too long for my toolbox, I wanted a simple way of hanging it from a nail. A hook in the end would do the trick, of course, but would also get in the way of my hand when I use the file. My solution of the problem was to countersink a small screw eye in the end of the handle and loop a piece of string through it. The same idea could be used for other tools.—R. G.

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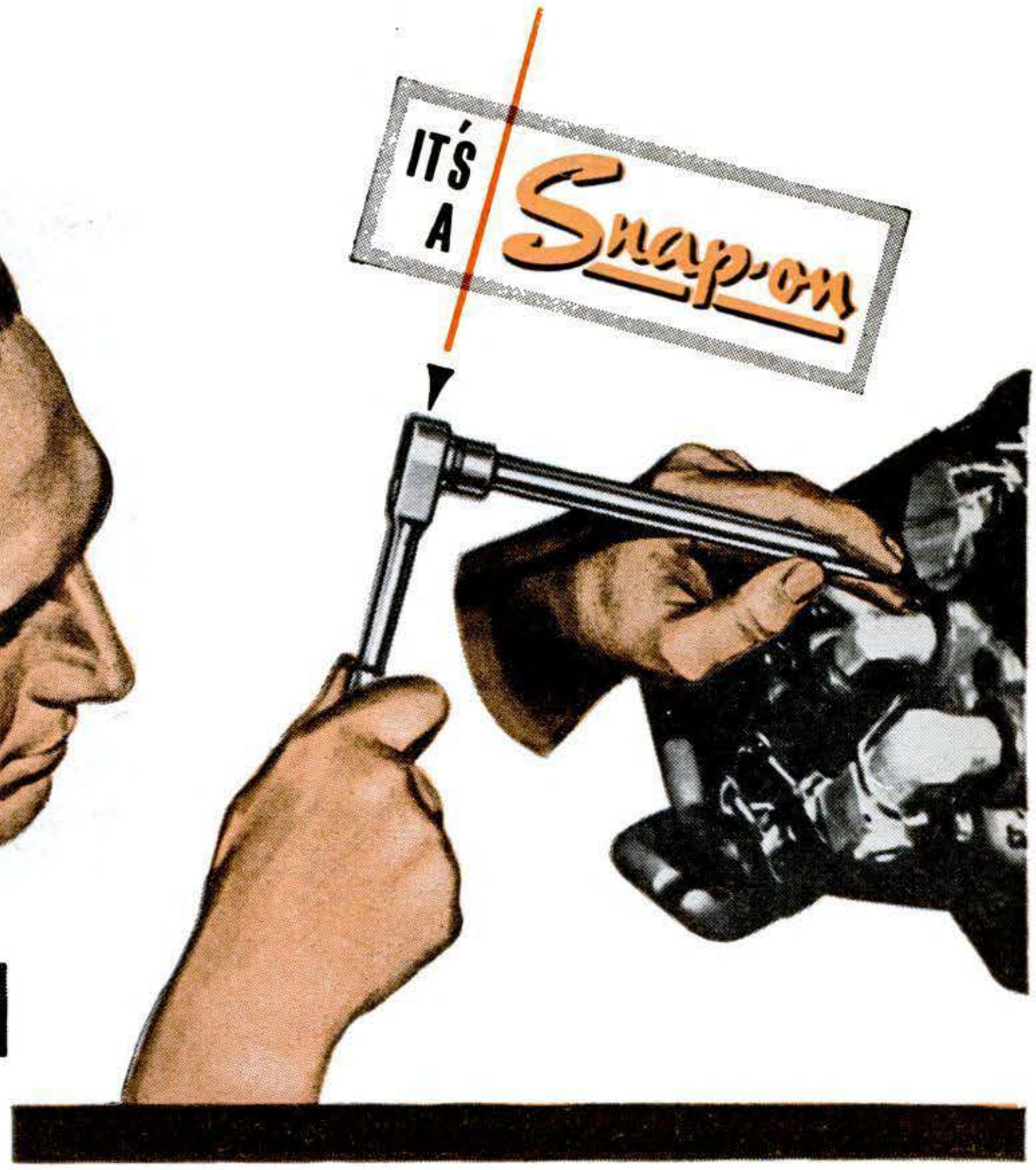

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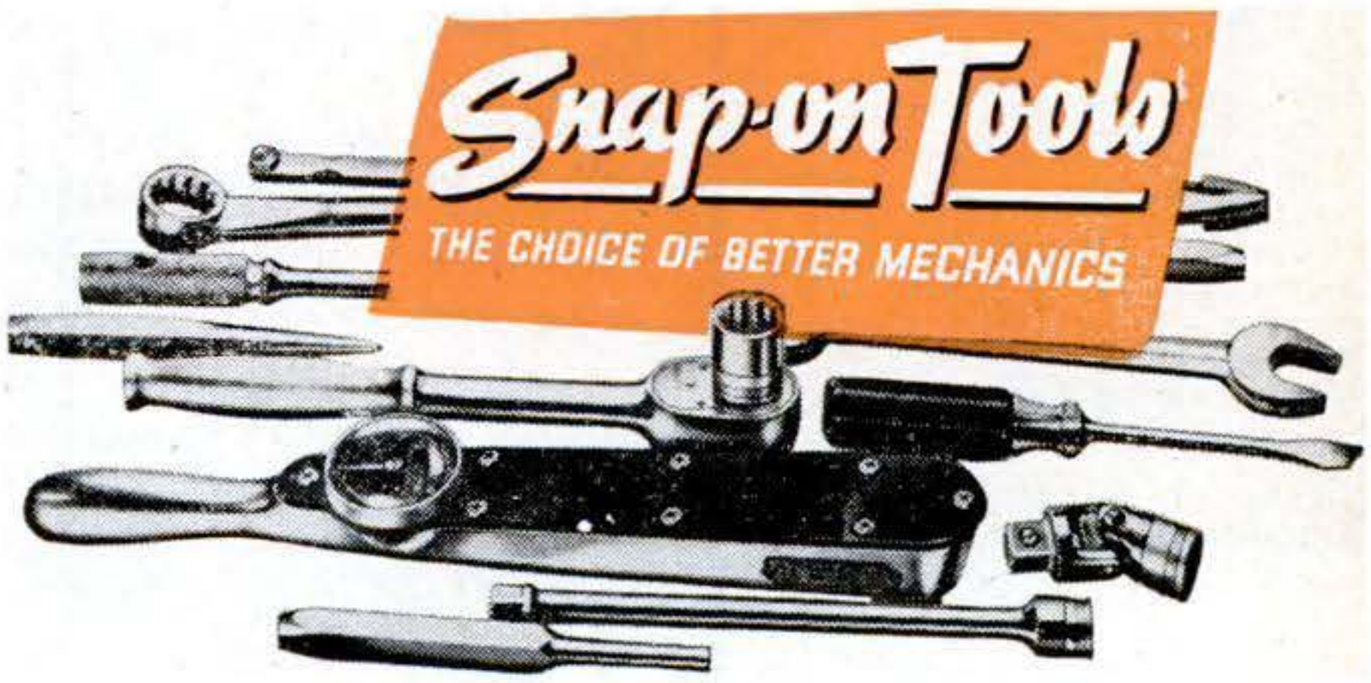

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12 October 1945

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Gentlemen:

I thought you might like to have a report on the Mercury Camera Shutter that your firm supplied to us in 1940 for use in our automatic motion picture camera for study of phenomena of the sun.

The shutter has performed amazingly and is still in operation after having exposed frame by frame, over 7000 feet of 16mm. motion picture film at 16 frames per foot, or over 112,000 exposures.

The Mercury shutter has proved extremely satisfactory under very trying conditions. We have been bothered considerably by extremely low temperatures at which the equipment must operate, but the shutter has gone on taking thousands of pictures, one after the other, with clock-like precision and no indication of change with age or temperature. The conditions of use have been very severe with zero and sub-zero weather common from October through April.

You may also be interested to know that the Mercury Shutter was picked after careful comparative tests of a number of different shutters, including the [redacted] and [redacted] and that we found the comparative performance for our application to be very much in favor of the Mercury.

It occurs to me that you might want to use the information for advertising purposes. If you wish to contact me, I shall be glad to supply any further details you may wish to have about this application of the Mercury shutter.

Very sincerely yours,

Walter Orr Roberts

Walter Orr Roberts

WOR/hcs

PERFORMED AMAZINGLY

STILL IN OPERATION AFTER 112,000 EXPOSURES

EXTREMELY SATISFACTORY UNDER VERY TRYING CONDITIONS

CLOCK-LIKE PRECISION

PICKED AFTER CAREFUL COMPARATIVE TESTS

COMPARATIVE PERFORMANCE VERY MUCH IN FAVOR OF THE MERCURY

*Cameras selling at 2½ and 4 times the price of the Mercury II.

it's the MERCURY II

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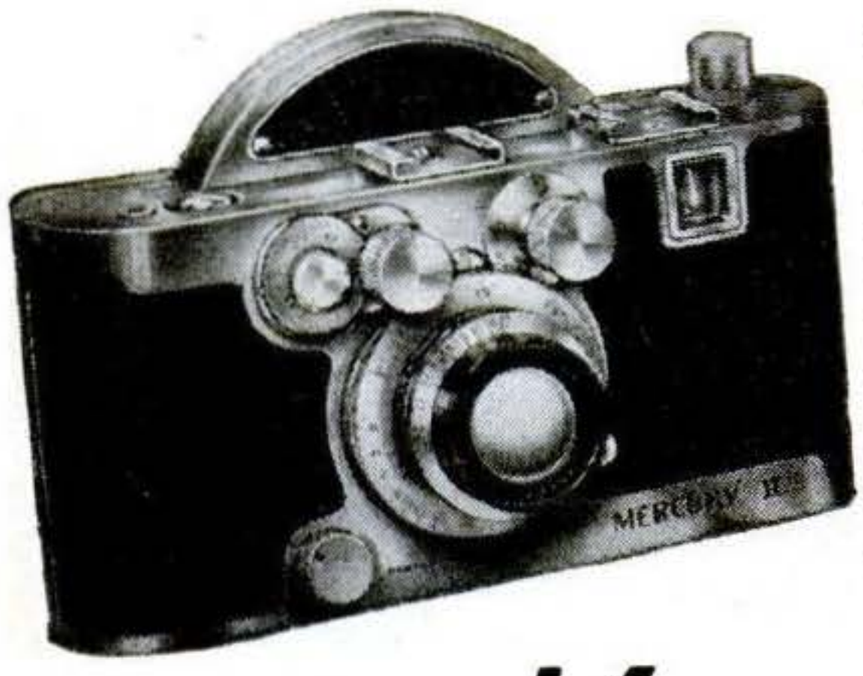

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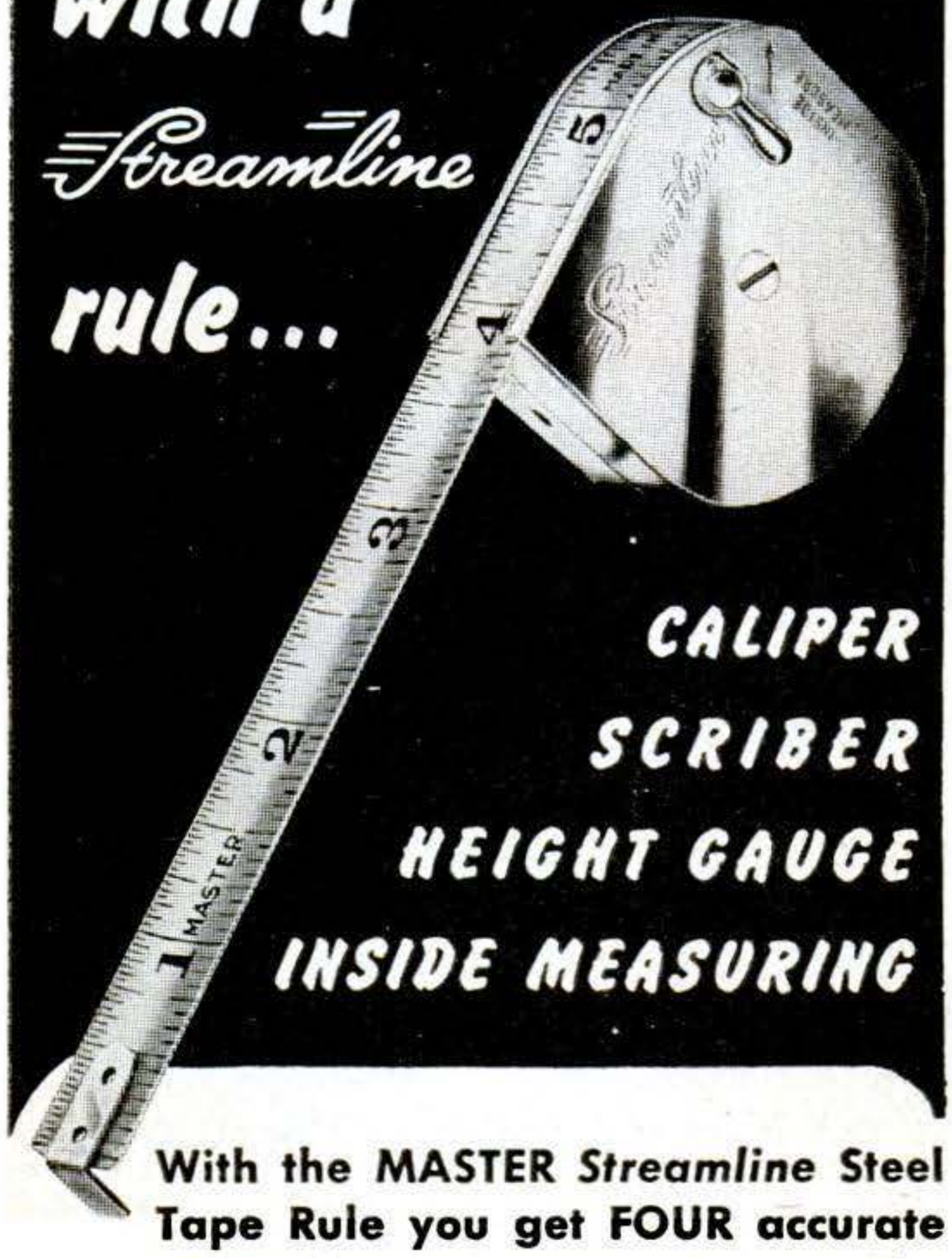

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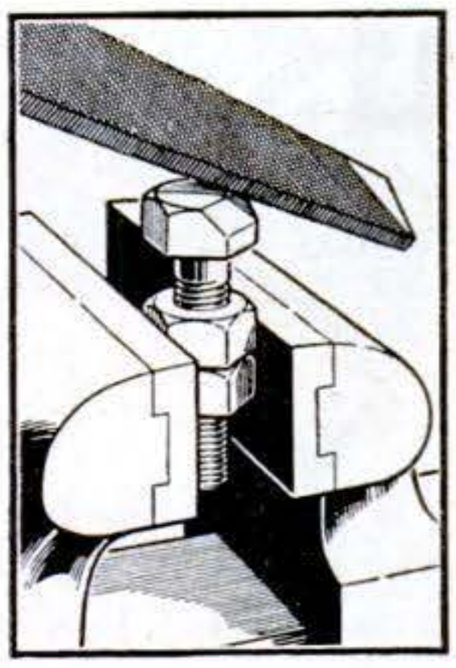
Jig Holds Shiplap for Nailing

A JIG for holding one end of shiplap while you nail the other can be made by driving a 4" spike through a two-by-four block and bending it to form a hook. Hang the jig over the last siding on the wall, and then take the next shiplap at the center and slide it between the jig and the studs. Nail down the far end and remove the jig by giving it a quarter turn.—R. H. LUND.

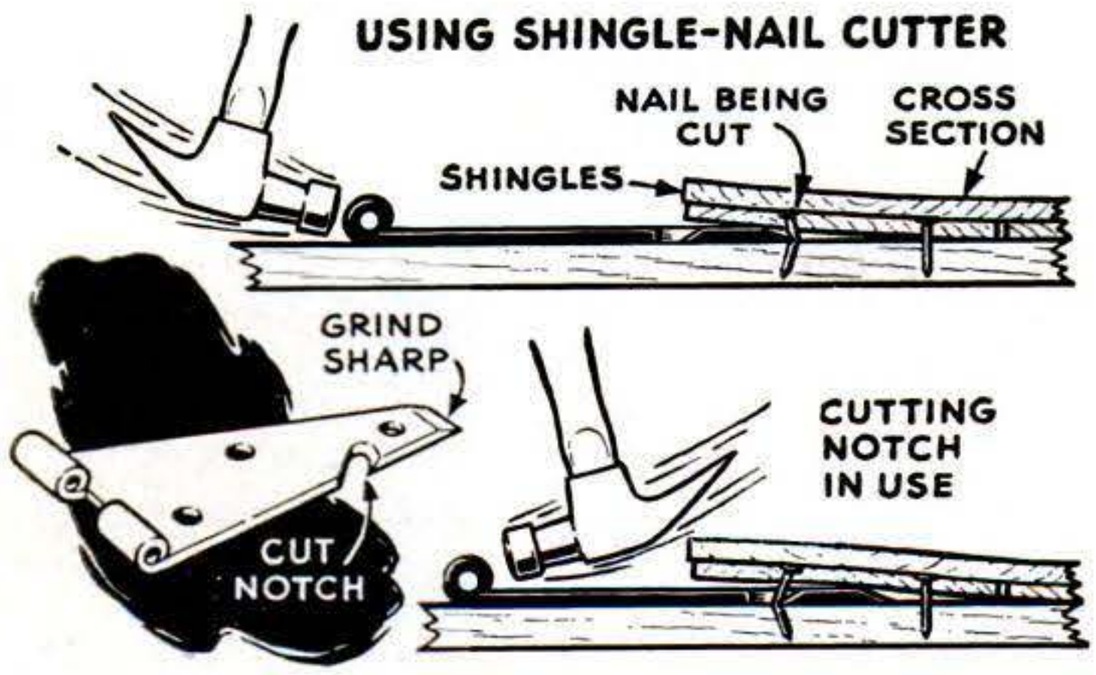
Filing Kink for Machine Screws

HEADS of machine screws may be filed without damage to the threads if two nuts are locked together on the threaded part and held in a vise. The jaws will then clamp the locked nuts instead of exerting pressure on the threads and marring them.—W. M.



Strap Hinge Cuts Shingle Nails

WHEN shingle nails interfere with the insertion of a new valley under the edge of roofing, they can be cut off with a long, sharpened strap hinge. A notch cut in the side of the hinge and then ground to an edge, as indicated in the drawing below, will catch nails that are missed when the hinge is driven in.—FRANCIS MANLEY.



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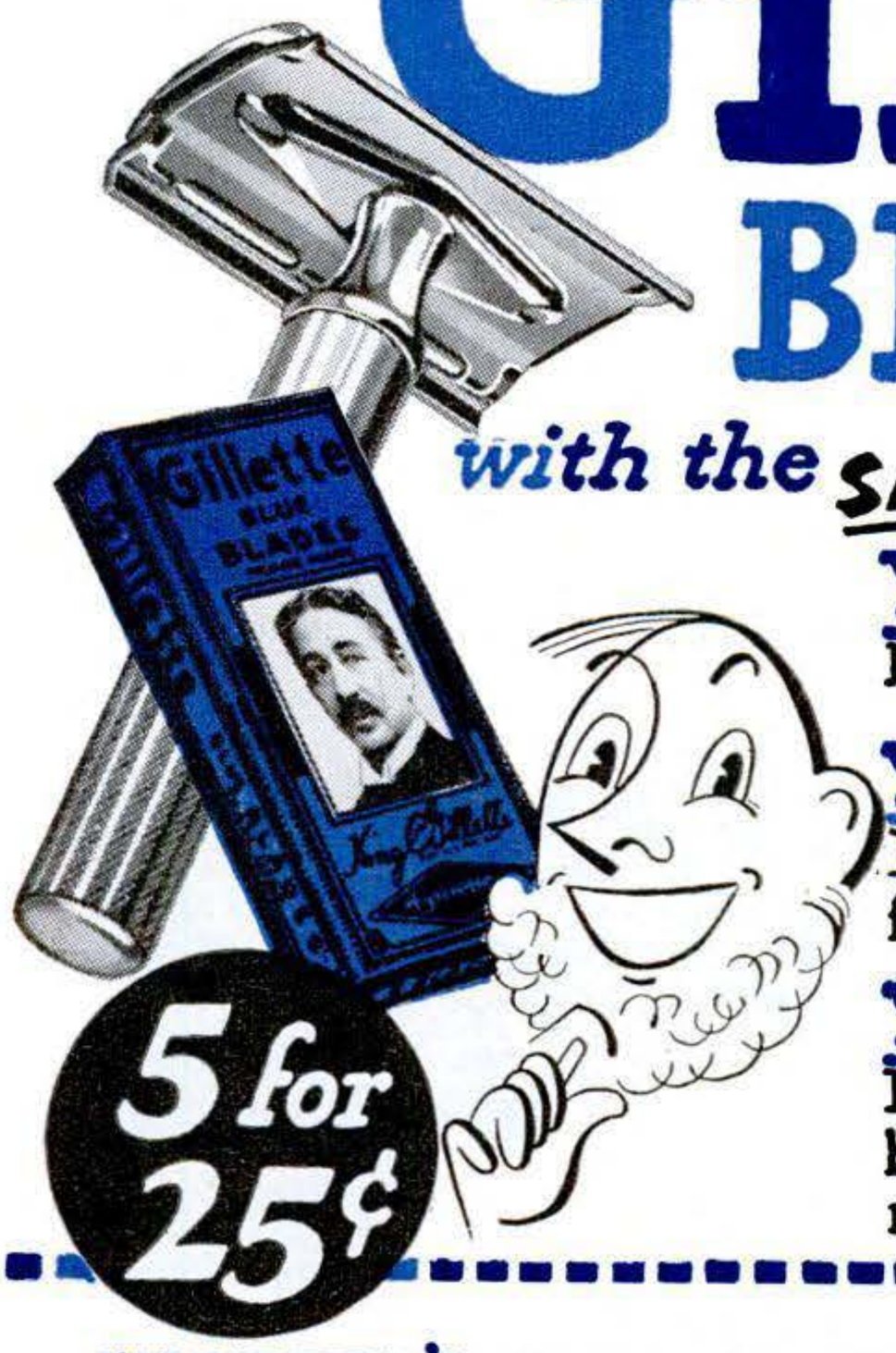
...be SHARP

use Gillette Blue Blades

with the ***SHARPEST*** *edges ever honed!*



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You feel SHARP because Gillette Blue Blades give you the quickest, most refreshing shaves of your life!

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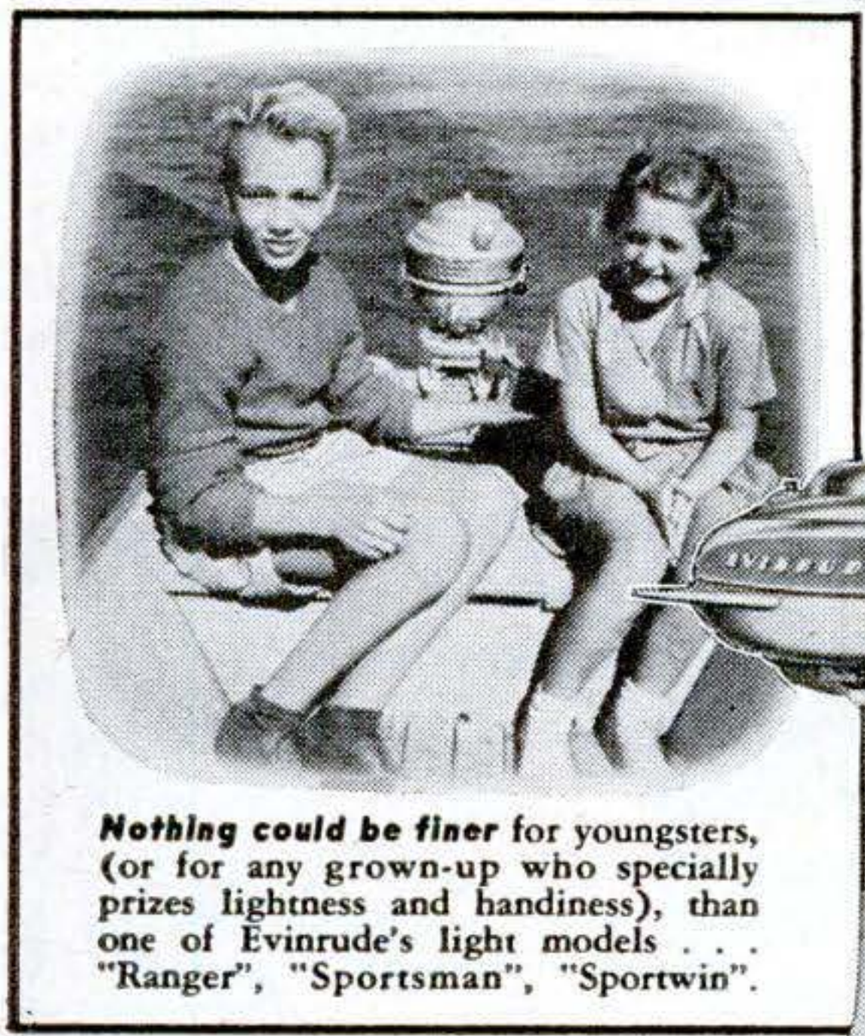
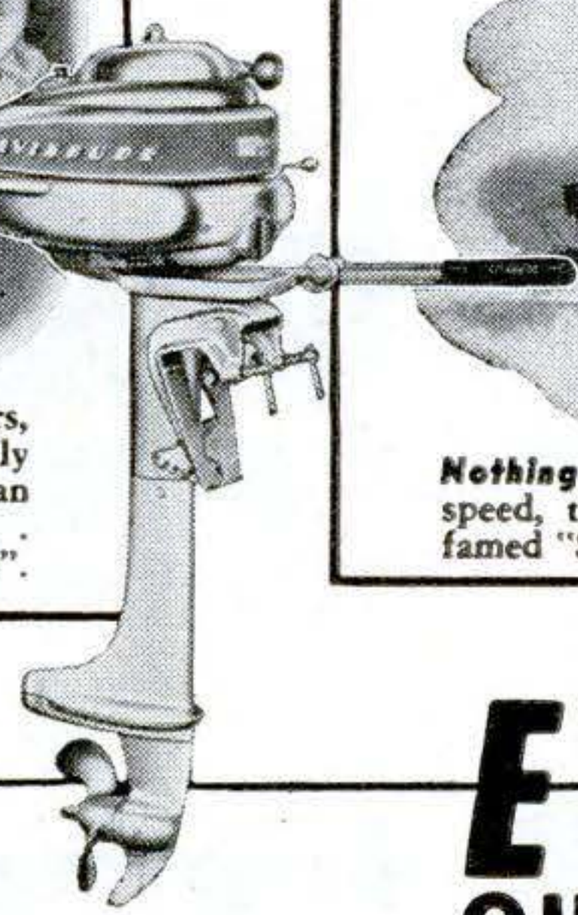


Nothing could be finer for youngsters, (or for any grown-up who specially prizes lightness and handiness), than one of Evinrude's light models . . . "Ranger", "Sportsman", "Sportwin".

Nothing could be finer, for the skipper who wants thrilling speed, than an Evinrude high-powered model — the famed "Speeditwin", the "Speedifour" and the "Big Four".



EVINRUDE
OUTBOARD MOTORS

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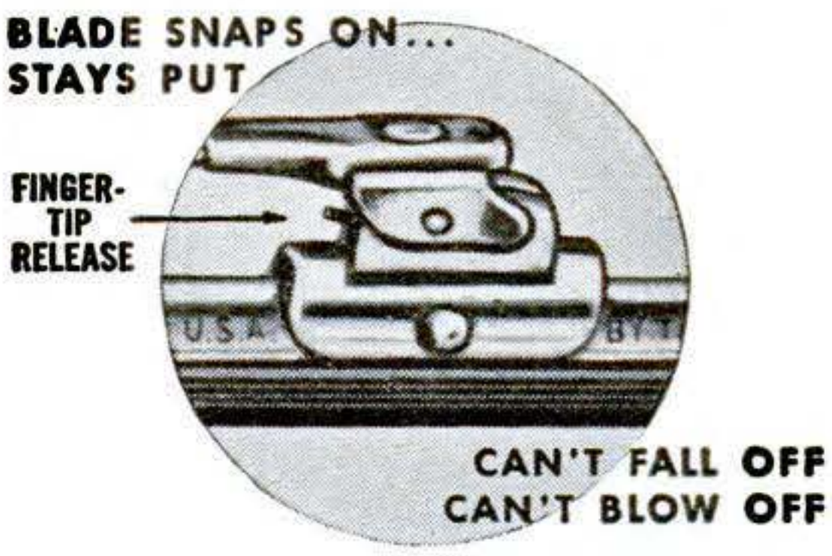

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Ask for RAIN-MASTER Windshield Wiper Arms and Blades next time you buy gas.

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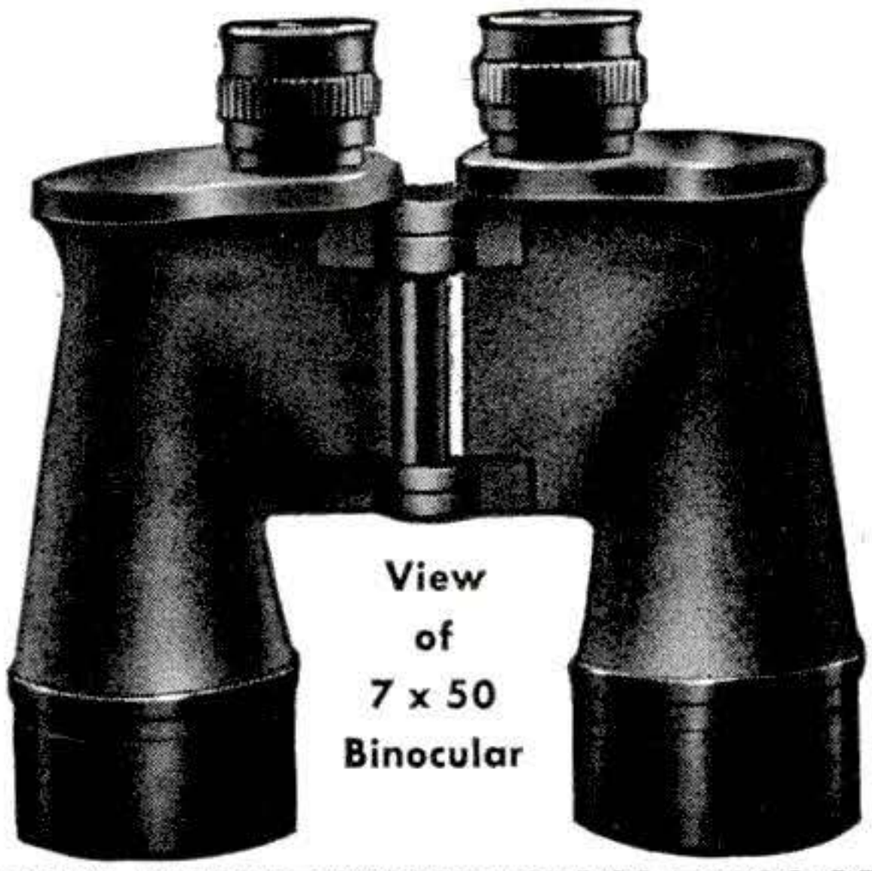
BARGAINS in WAR SURPLUS LENSES & PRISMS



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The Man Who Wouldn't Stay Licked

*So inconspicuous

...and so, Bill. I'm back on top again. Yet, only a year ago, I thought I was licked because my hearing had gone bad.

It must have been failing for years but I wouldn't admit it. Then came the day when I said "no" on a big deal when I should have said "yes."

After that, I went to an ear specialist. He recommended a hearing aid. Fortunately, I tried a new Zenith.

So, now I'm sitting pretty, hitting on all eight cylinders. Yep, Bill, I can hear again, and the world's my oyster...

* * *

If you want to start friends or relatives who are hard of hearing back on the road to happiness—suggest that they visit a Zenith dispenser and try a new Zenith Radionic Hearing Aid. You owe it to them. They want to hear you but it's embarrassing when you shout.

Their own ears will decide—no one will ask them to buy. And the new Neutral-Color Earphone and Cord is so *inconspicuous*. Remember—Zenith has always stood for quality.

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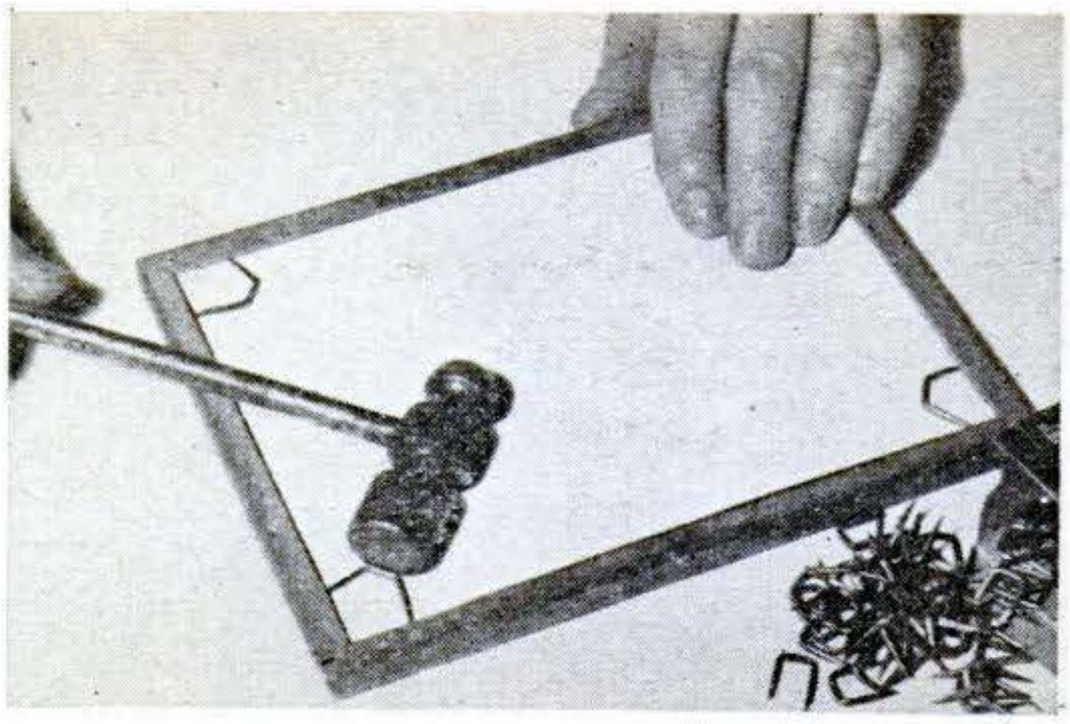
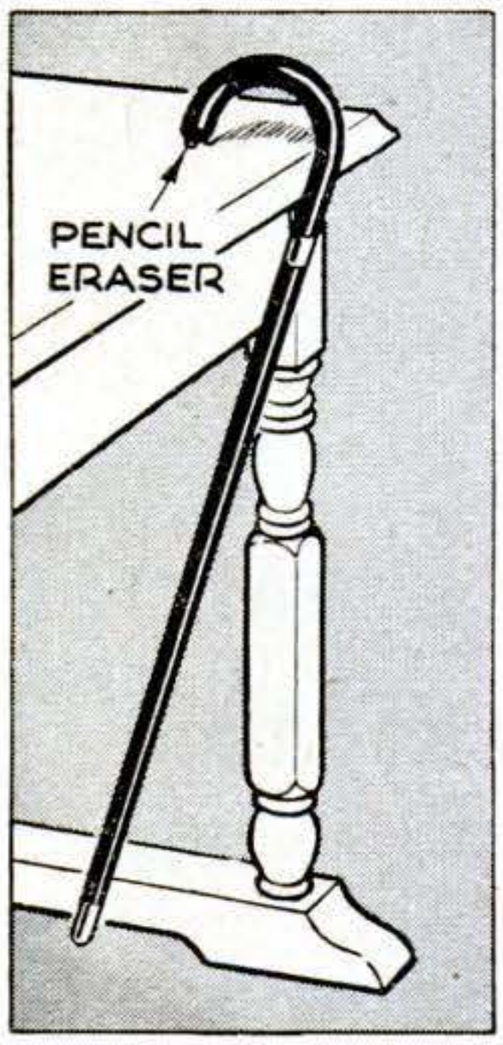


Staples Used in Framing Pictures

SMALL staples such as those shown in the photo above are excellent for use in framing pictures. Bend them slightly apart with pliers so that the ends can be hammered into the frame across the corners in the manner indicated.—H. KLEIN.

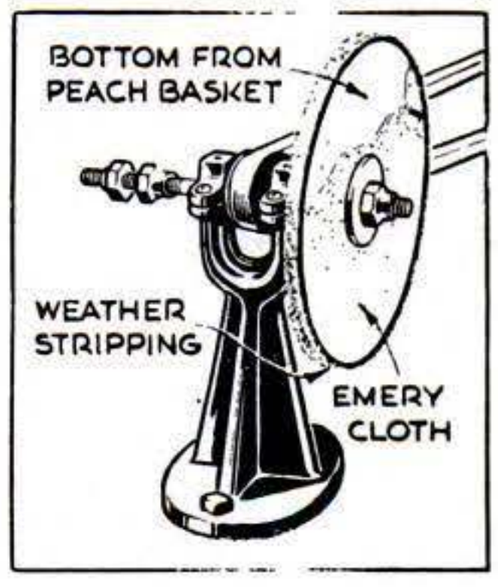
Eraser Keeps Cane from Slipping



THOSE accustomed to carrying a cane will realize how embarrassing it sometimes can be to have the cane clatter to the floor when it has been hooked over a table or desk. This nuisance can be eliminated by gluing a pencil eraser in a small hole drilled in the handle end of the cane. I have been using the idea for quite a long time and have found it satisfactory.—C. V. G.

Abrasive Wheel from Basket Bottom

CENTERED on a polishing-head shaft, the bottom of a peach basket provides a base for an efficient abrasive wheel. Since the washer on the shaft is all that is needed to hold a sheet of sandpaper or emery cloth against the wheel, the type of abrasive can be changed as often as required. Dime-store weather stripping on the edge makes a good buffer.—*A. G.*



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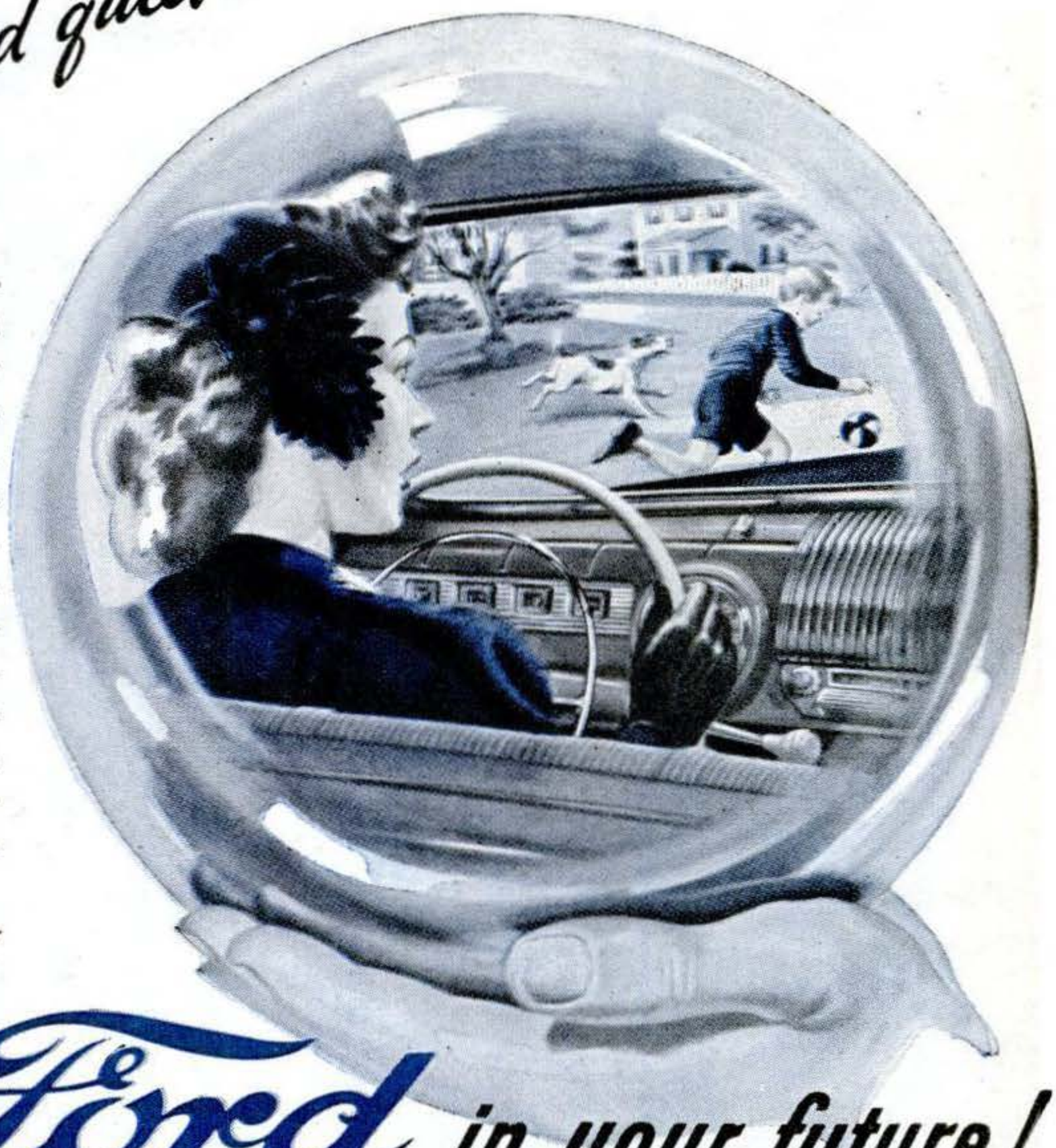
Brakes to trust ...quick and quiet!



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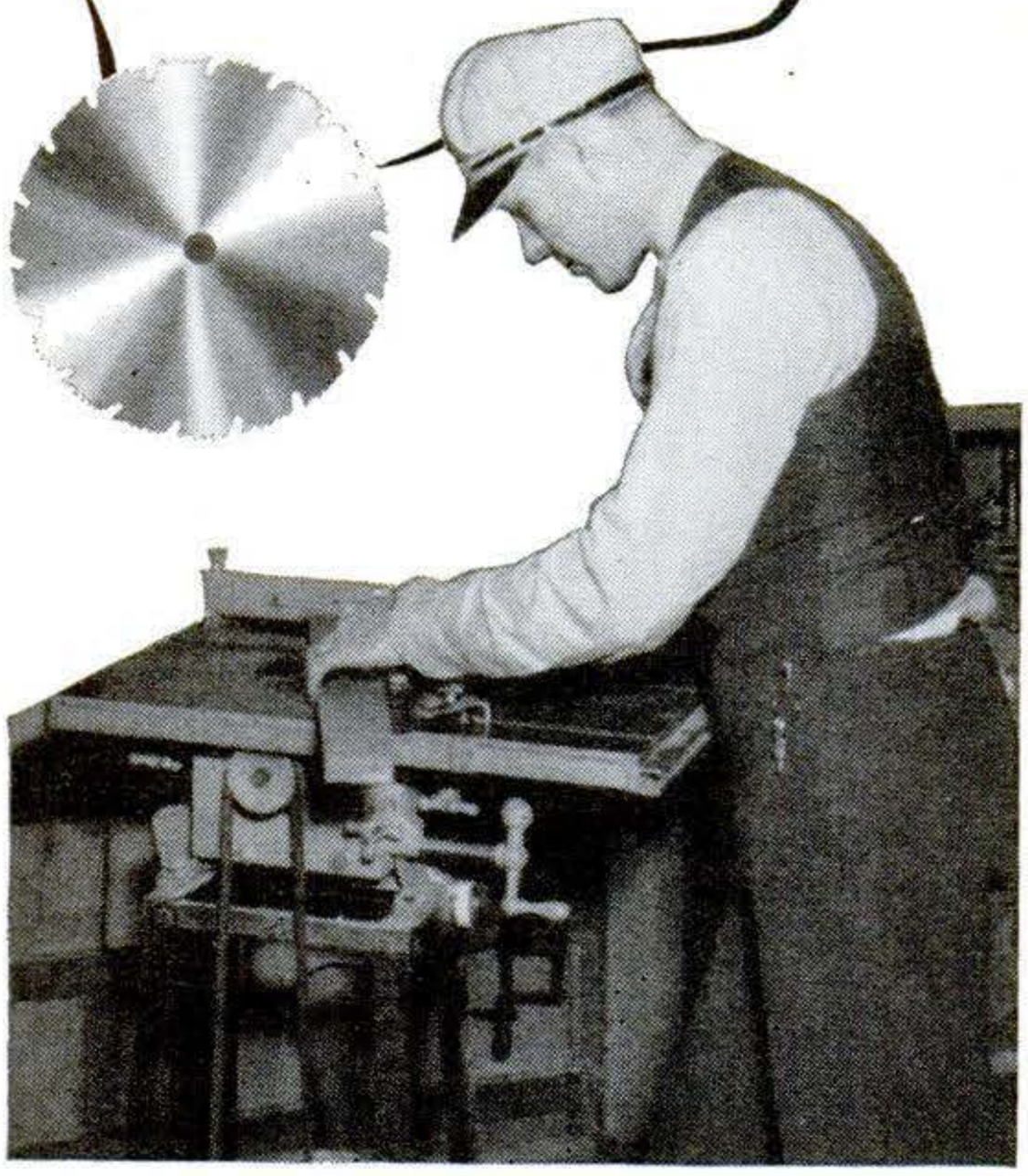

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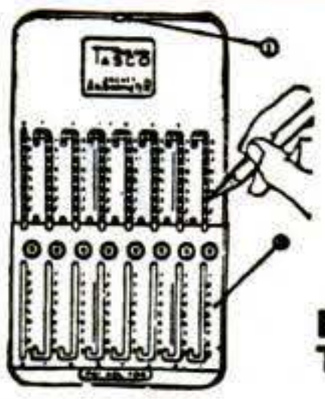

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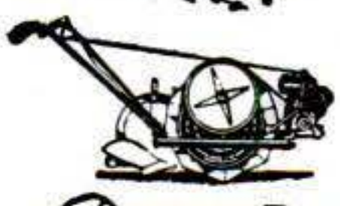

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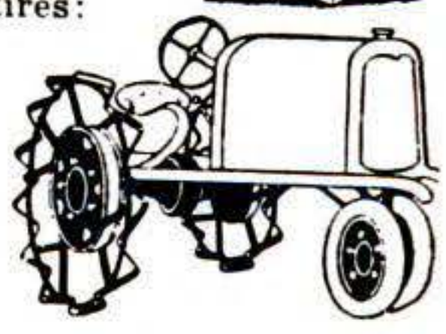

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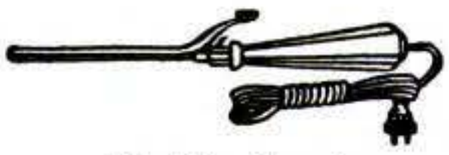

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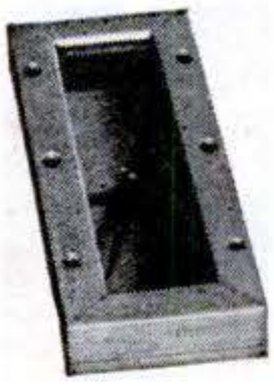

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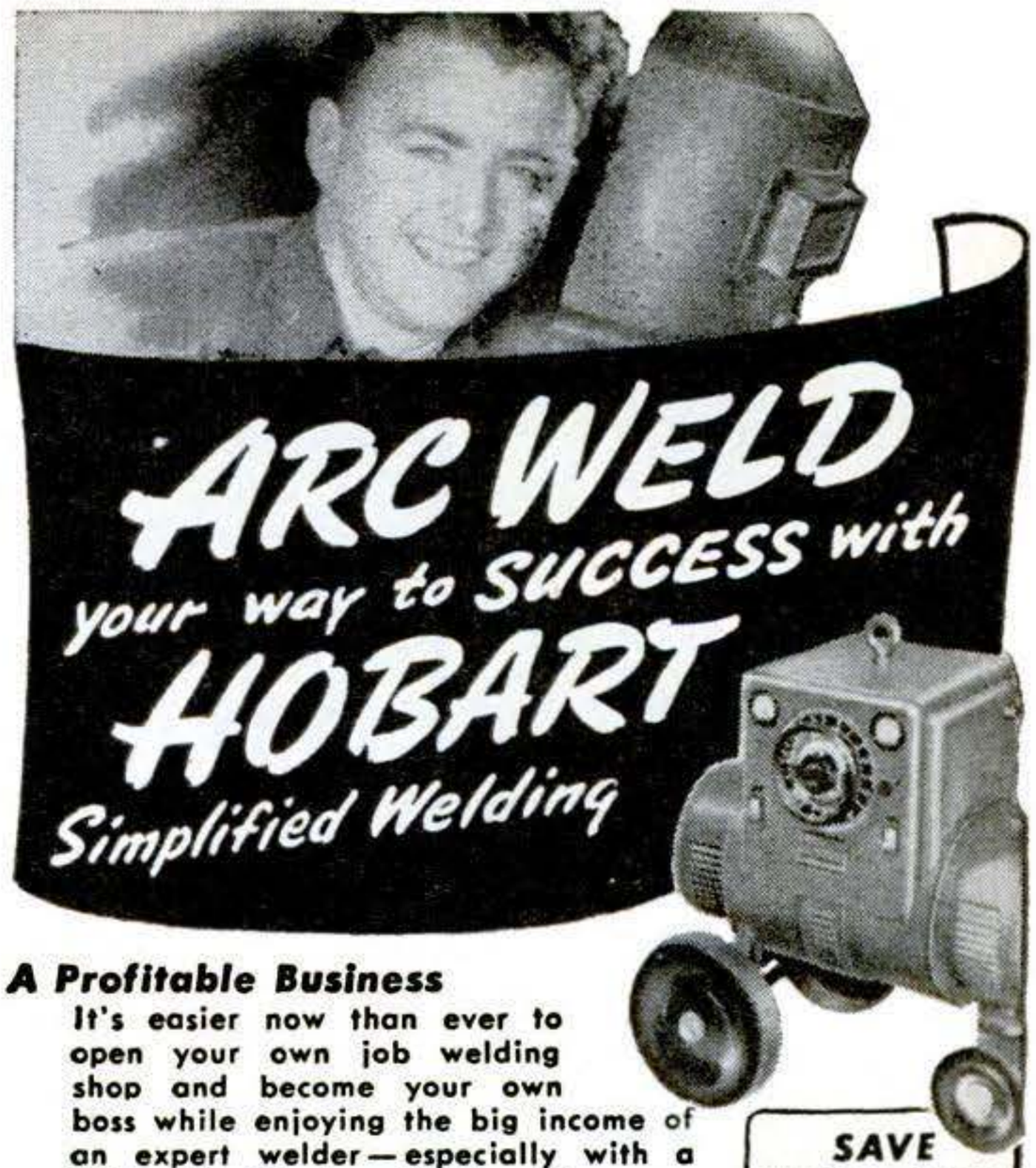

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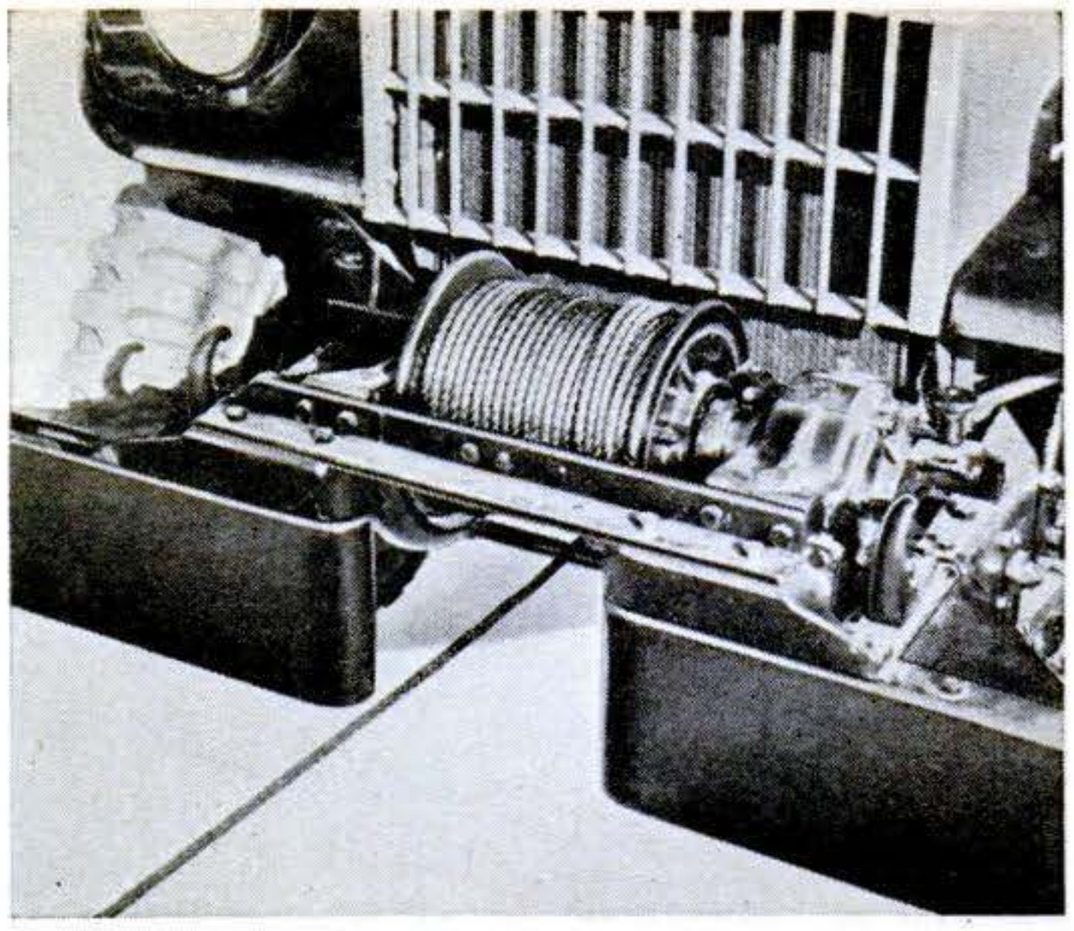

Controlled from the driver's seat, this power winch has 250' of steel cable and a capacity of 7,500 lb.

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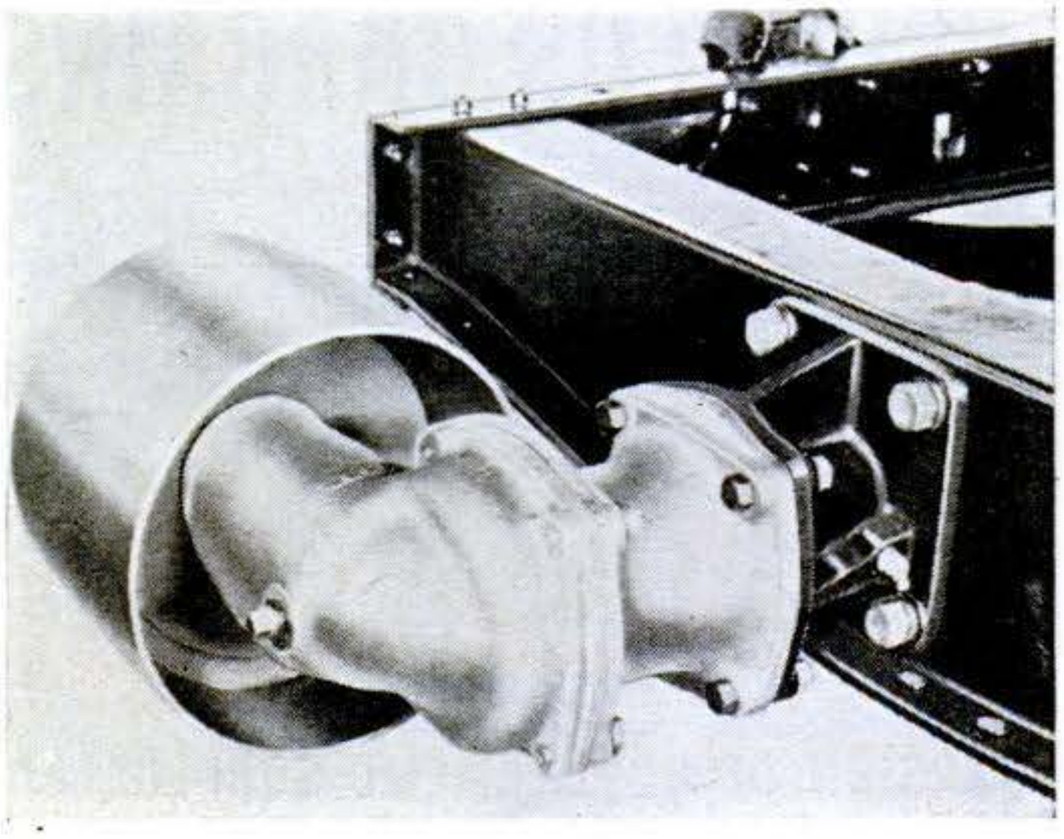

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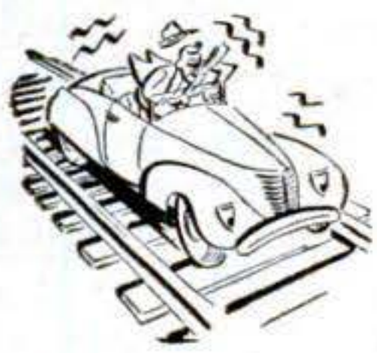

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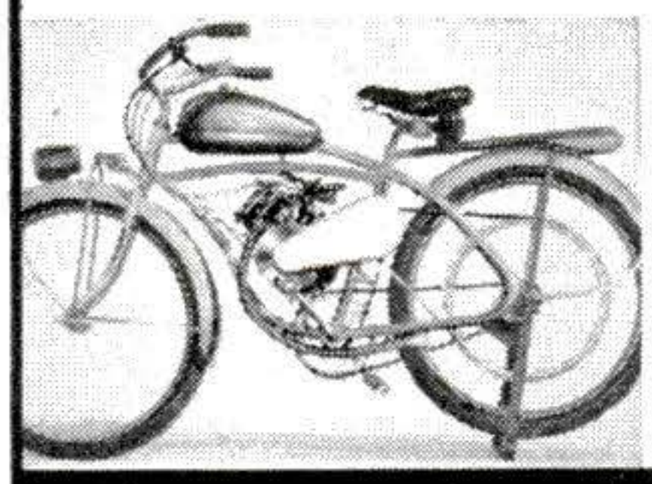

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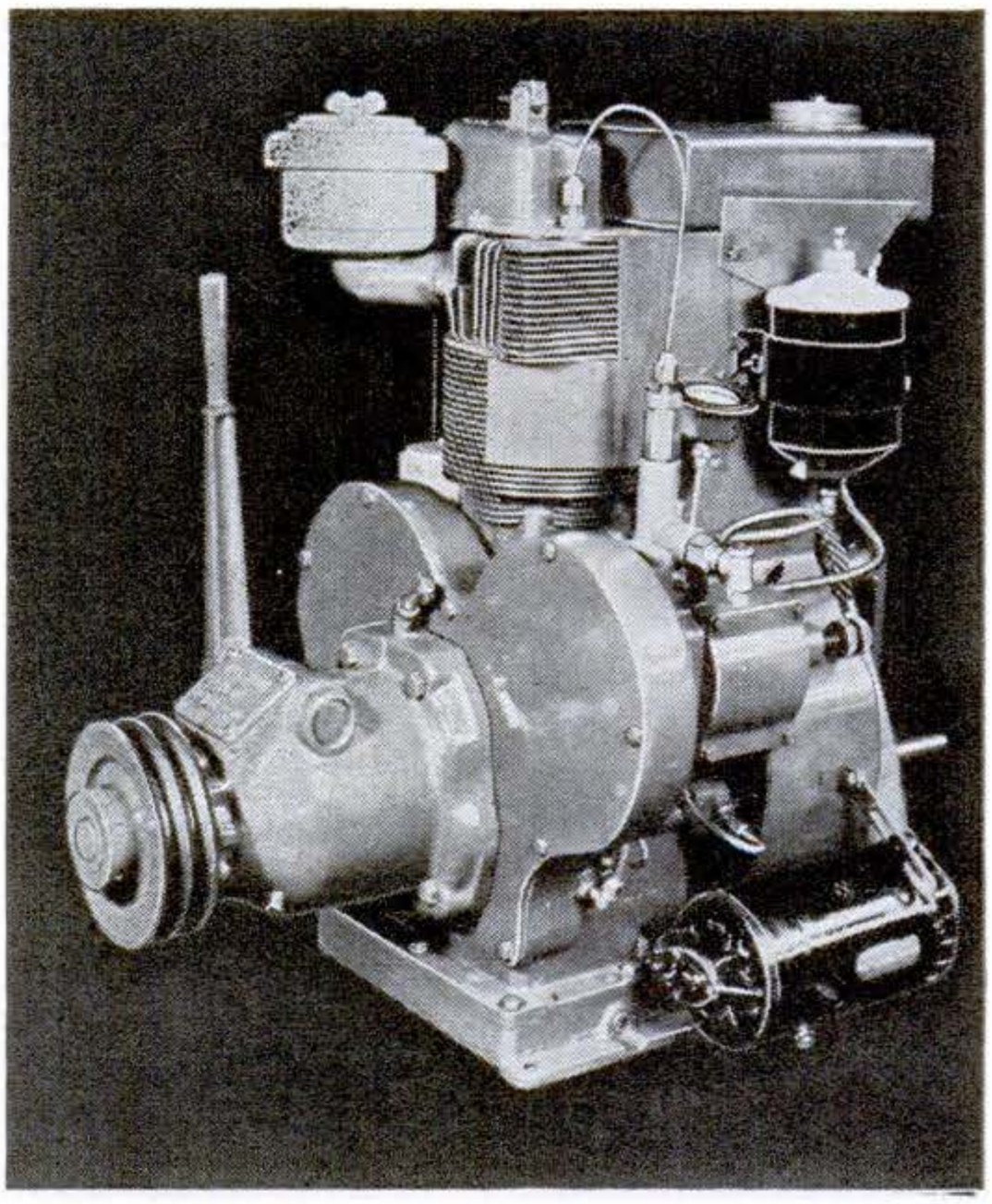

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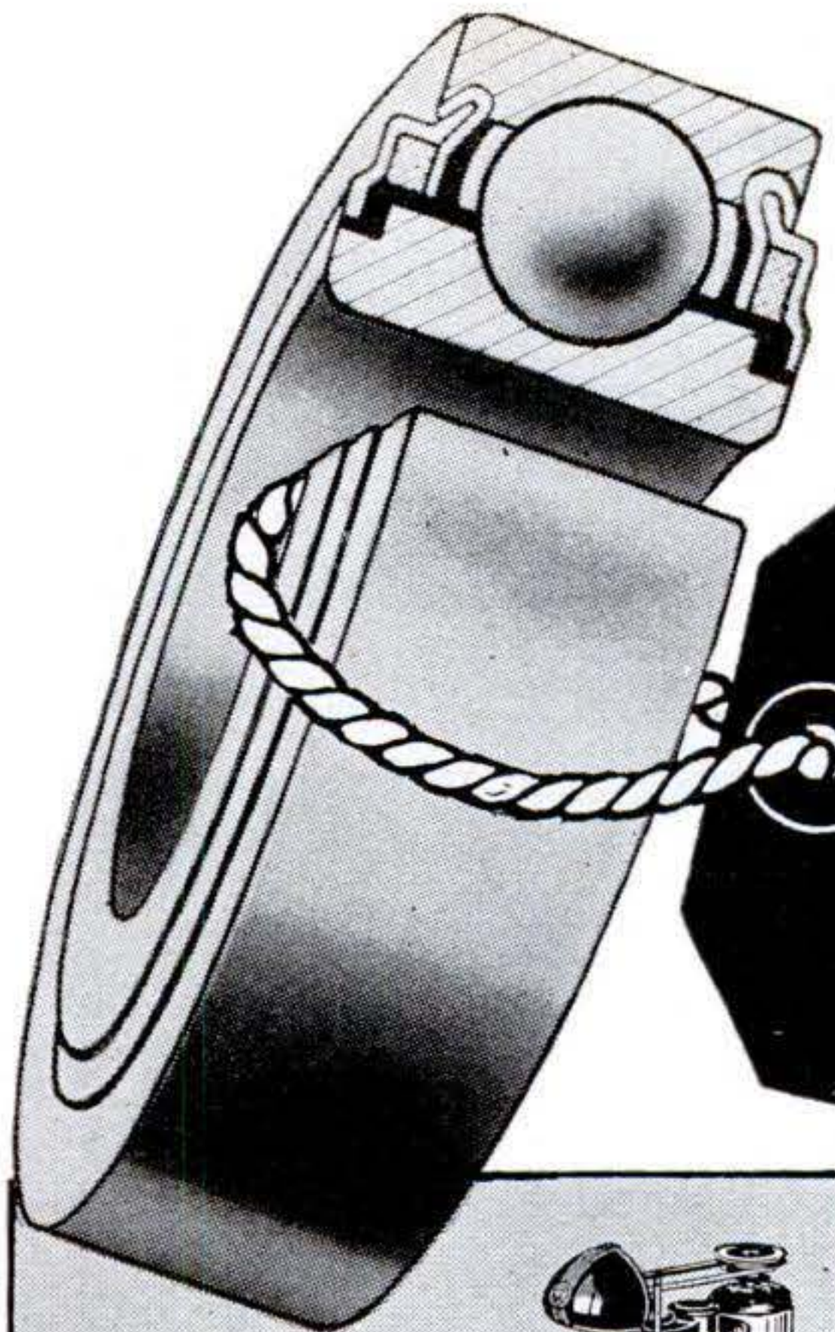

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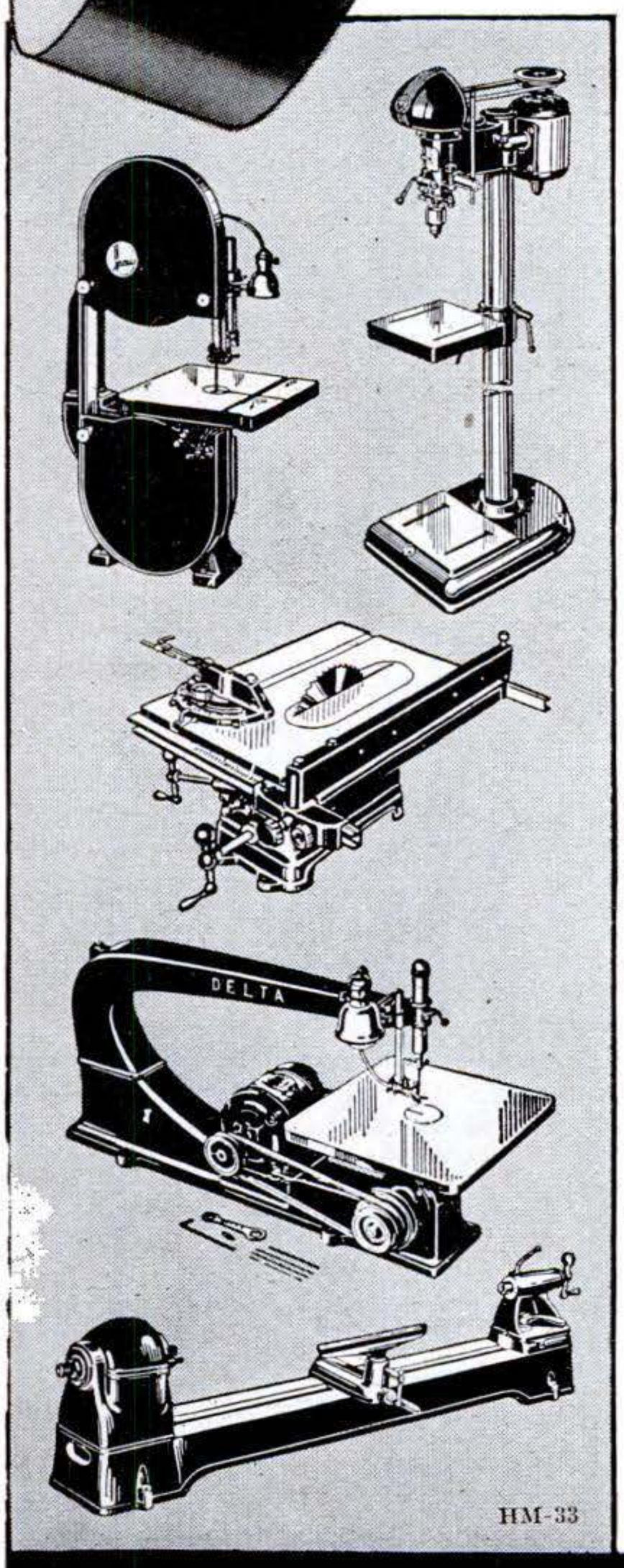

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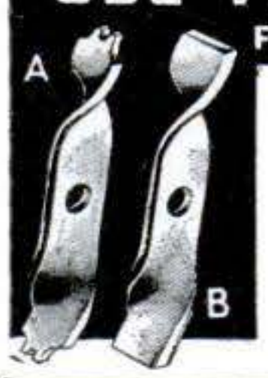

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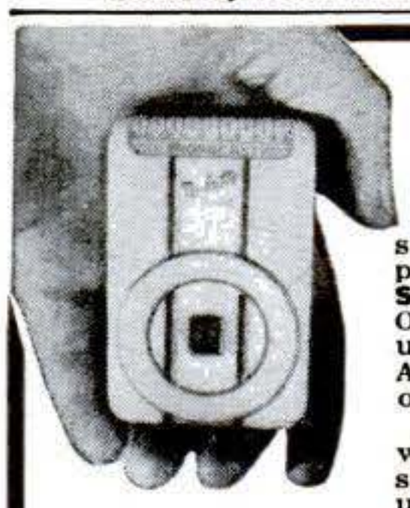

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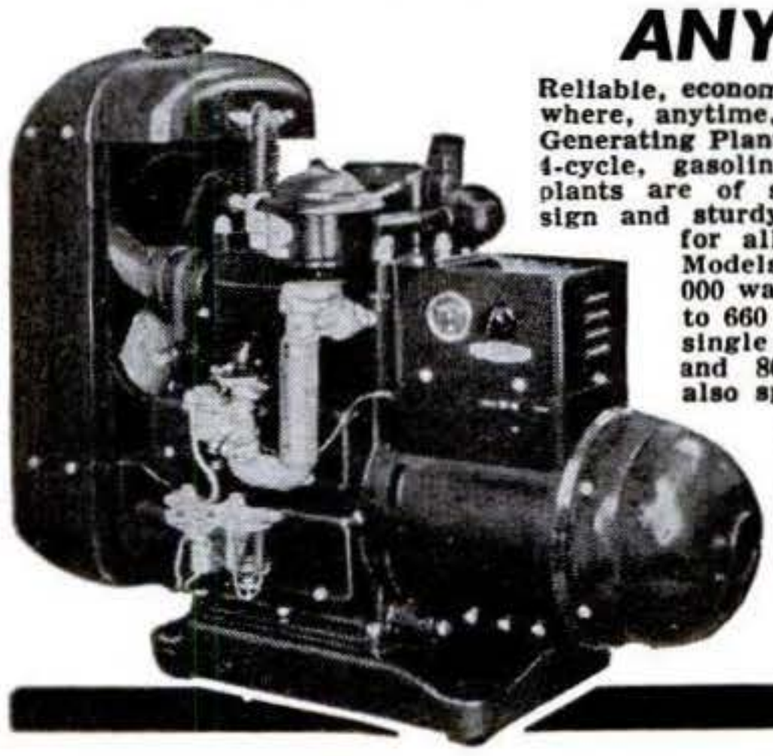

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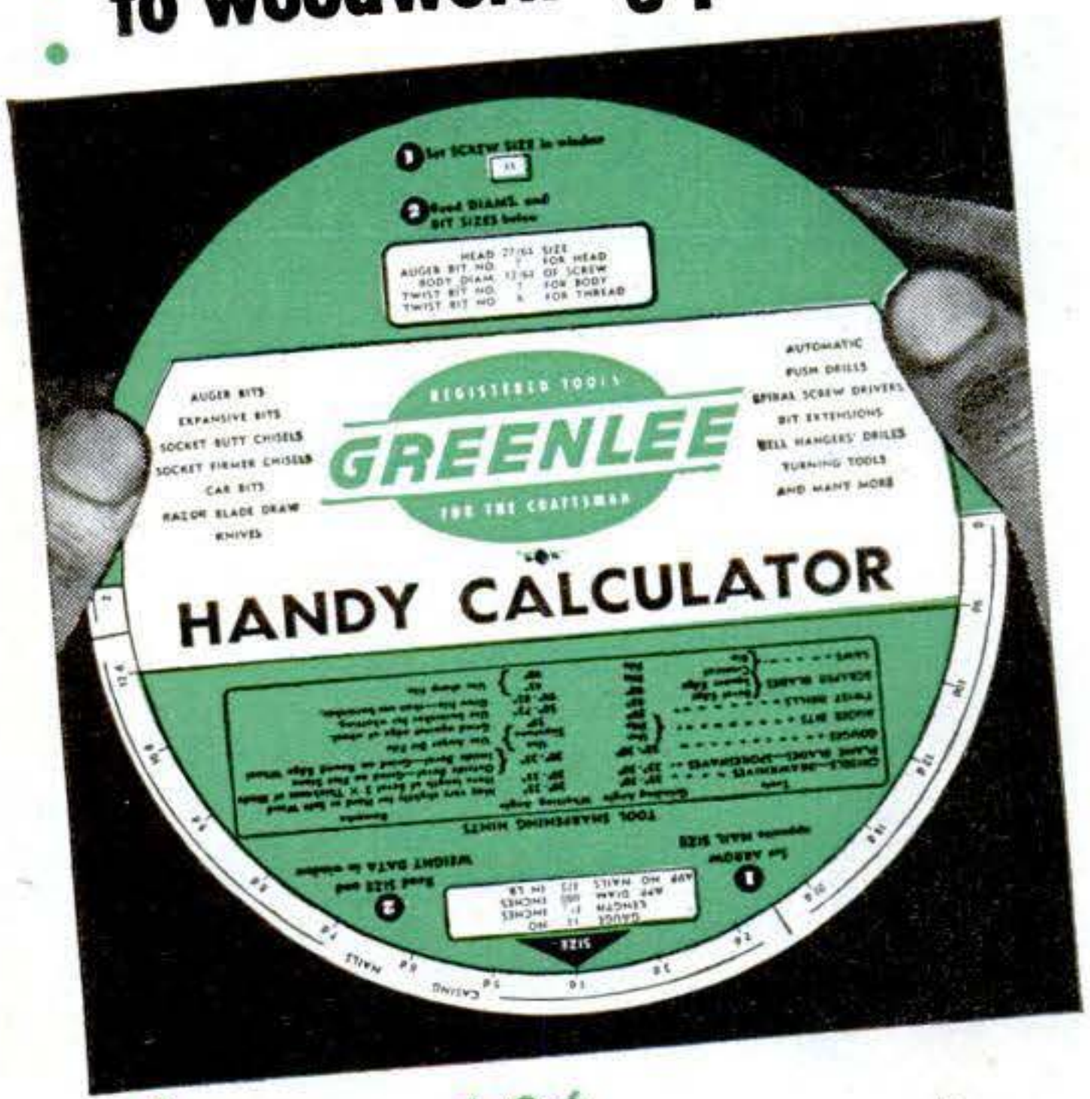

Only 10¢ for this easy-reading GREENLEE Woodworker's Calculator. With it you swiftly convert linear feet to board feet...get slope per foot in degrees... compare hardness, weights, shrinkage, warping, working ease of various woods. Also—bit sizes for head, body, thread of screws...nail specifications...tool sharpening hints...protractor. 6" diameter. Heavily varnished cardboard. Special offer...send coupon and 10¢ (not stamps). Greenlee Tool Co., Rockford, Illinois.

Makers of high-quality woodworking tools—auger bits, chisels, gouges, spiral screwdrivers, and many more.

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Outstanding Inventions Of 1945's Sparse Crop

ALTHOUGH only about 500 patents a week were issued during 1945, a low average consistent with the previous war years, some outstanding inventions were patented. Here are a few of them:

Antiknock motor fuels, produced through the addition of compounds of heavy metals other than lead.

An apparatus employing streams of electrons or gamma rays to search thick steel plates for hidden flaws.

Electric wires insulated with a coating of sodium silicate that are flexible and highly resistant to water.

A war-born high explosive called pentolite, consisting of PETN, mixed with TNT, insensitive to shock, but more violent than TNT.

Rubber separated out of macerated native goldenrod by adding an alkali salt to the flotation medium.

A new-type motion-picture theater that has the screen on the ceiling and reclining couch seats.

A flexible "iron lung" that encloses the torso only and enables the patient to change position and move more freely.

With the release of many inventors from the armed services and from war industries, the number of patents issued on new inventions is expected to increase sharply in the coming months.

A new and interesting undertaking of the Patent Office, which is expected to benefit both inventors and manufacturers, is the weekly publication in the Official Gazette of a register of patents which the owner is willing to sell or license. It is intended to help American businessmen in finding new devices to make and sell, and many mutually profitable bargains between inventors and manufacturers already have been struck.

Comet Finder Du Toit Discovers Third One in a Year

A HITHERTO undiscovered comet of the seventh magnitude has been found by D. du Toit in the vicinity of the Southern Cross. Du Toit, who is a member of the Harvard Observatory Staff at Bloemfontein, South Africa, is credited with finding two faint comets earlier in 1945. The new comet is out of reach of telescopes in the United States, as it was seen in the constellation of Triangulum Australe, the southern triangle. It was moving eastward at the rate of 30 minutes a day.

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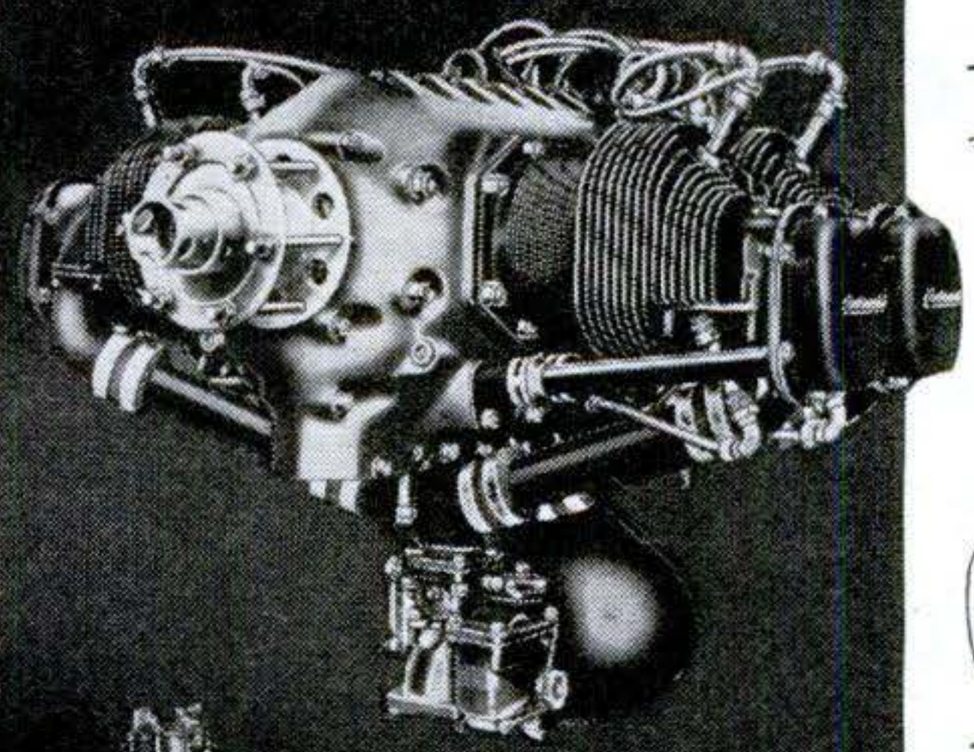
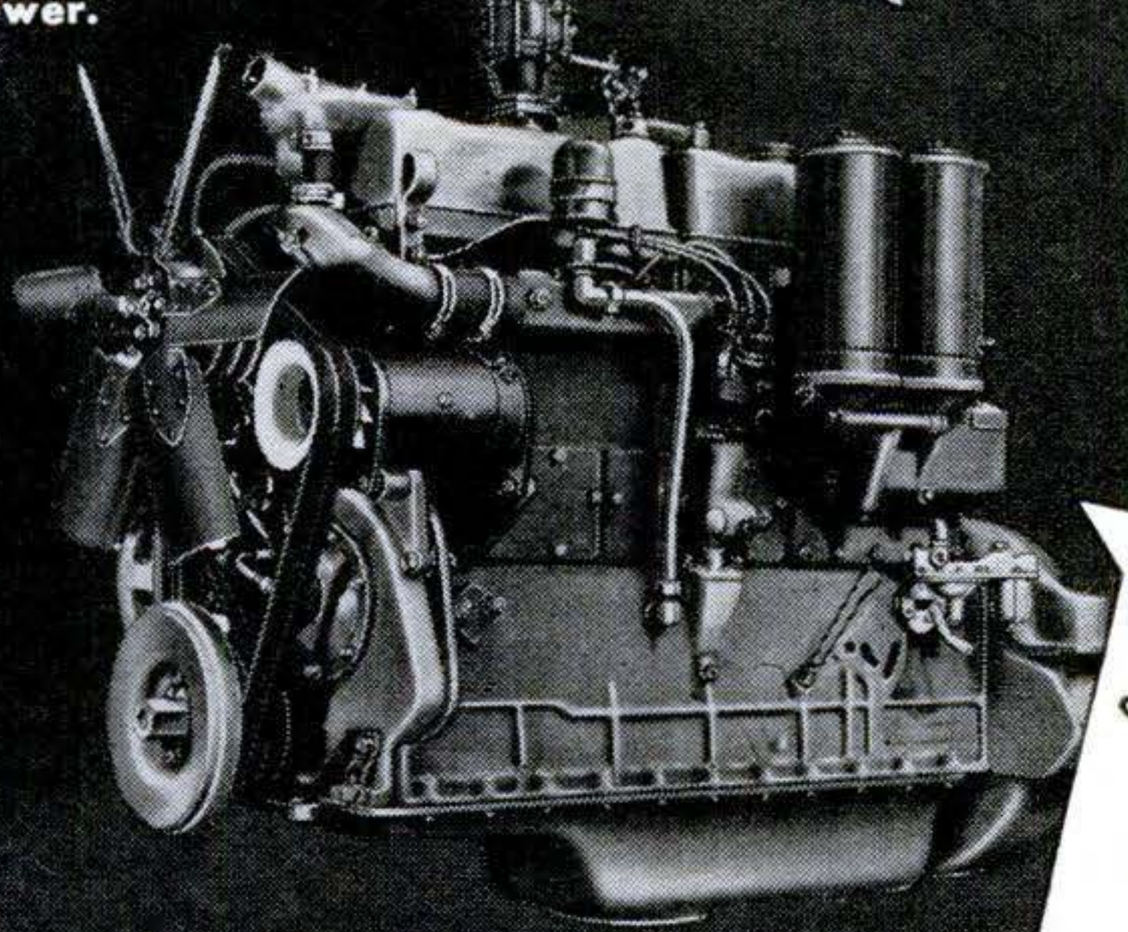
FROM 5/8 TO 2,200 HORSEPOWER

CONTINENTAL *Red Seal Engines*

Here's Tiny Tim, Mighty Atom of the Red Seal Family. Gives Light and Power wherever you go — Farm, Camp, Wilderness. Light in weight, easily carried. A self-starting portable electric generator always at your service. It's 5/8 H. P. Two-quart self-contained gasoline tank holds enough to run engine eight hours.

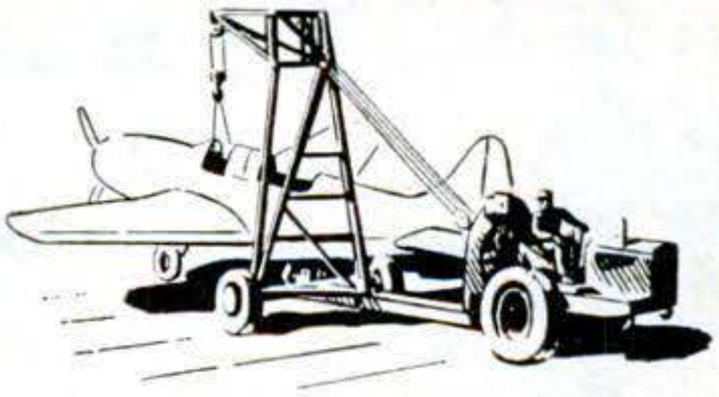


And here's the C-75-85 (horsepower) Aircraft Engine which powers most light planes. Dependable, economical—4-cylinder. It's the improved 1946 model of famous Red Seal "A" Engines which made flying possible for thousands. Other engines in the Continental family range up to the I-1430 aircraft engine of 2,200 horsepower.

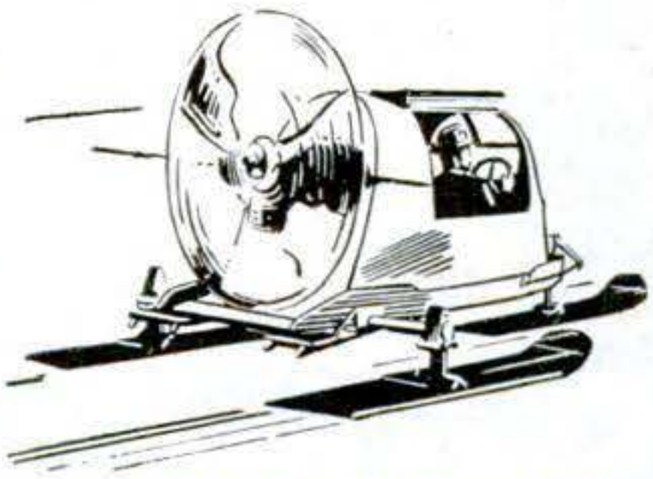


Or if you are looking for a rugged "workhorse" engine for powering trucks, buses, earth movers, compressors, cranes, air conditioning or refrigeration units, this 140 H.P. R-600 Red Seal engine will do your job reliably and economically.

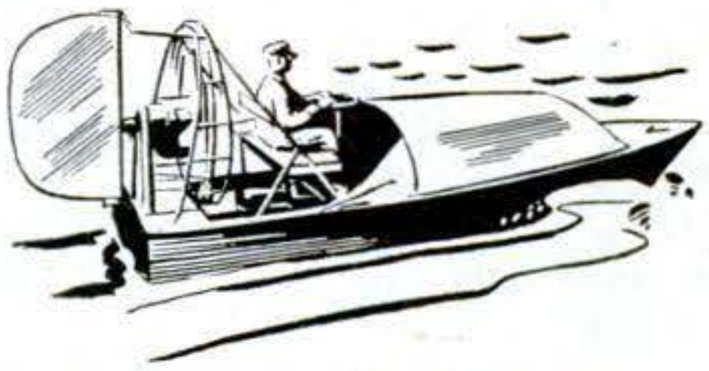
Continental Motors Corporation
MUSKEGON, MICHIGAN



Adaptability! Another great Red Seal characteristic — Continental powered Flight Deck crash cranes that hauled crippled War Birds out of danger's way aboard Aircraft Carriers.



For the thrill of a wintertime, this Snow-mobile glides swiftly over the white horizon, with Red Seal powering the airplane propeller at rear.



To the rescue in an Army-Navy Swamp Glider . . . Just another call on Continental versatility . . . and a Red Seal Engine, plus airplane propeller, gets this speedy craft in and out of difficult waters.

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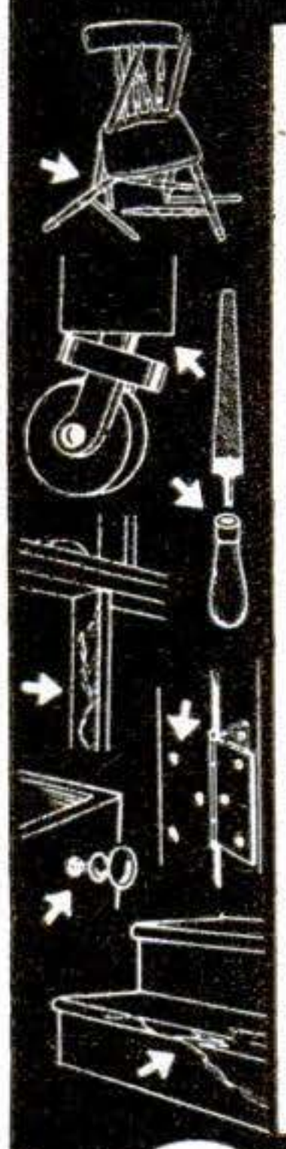

Cracks, holes, dents in wood, plaster, concrete, metal, etc. — loose handles, rungs, knobs, screws — mistakes in carpentry, etc. — fix them *all* with Savogran Crack Filler (hard as stone) or Savogran Wood Putty (easily tooled). Just mix with water, press into place. Stays put, hardens quickly, will not shrink! Can be painted pre-colored. Ideal for models, inlays, etc. Patented! Big 1-lb. can only 30c at hardware and paint stores.

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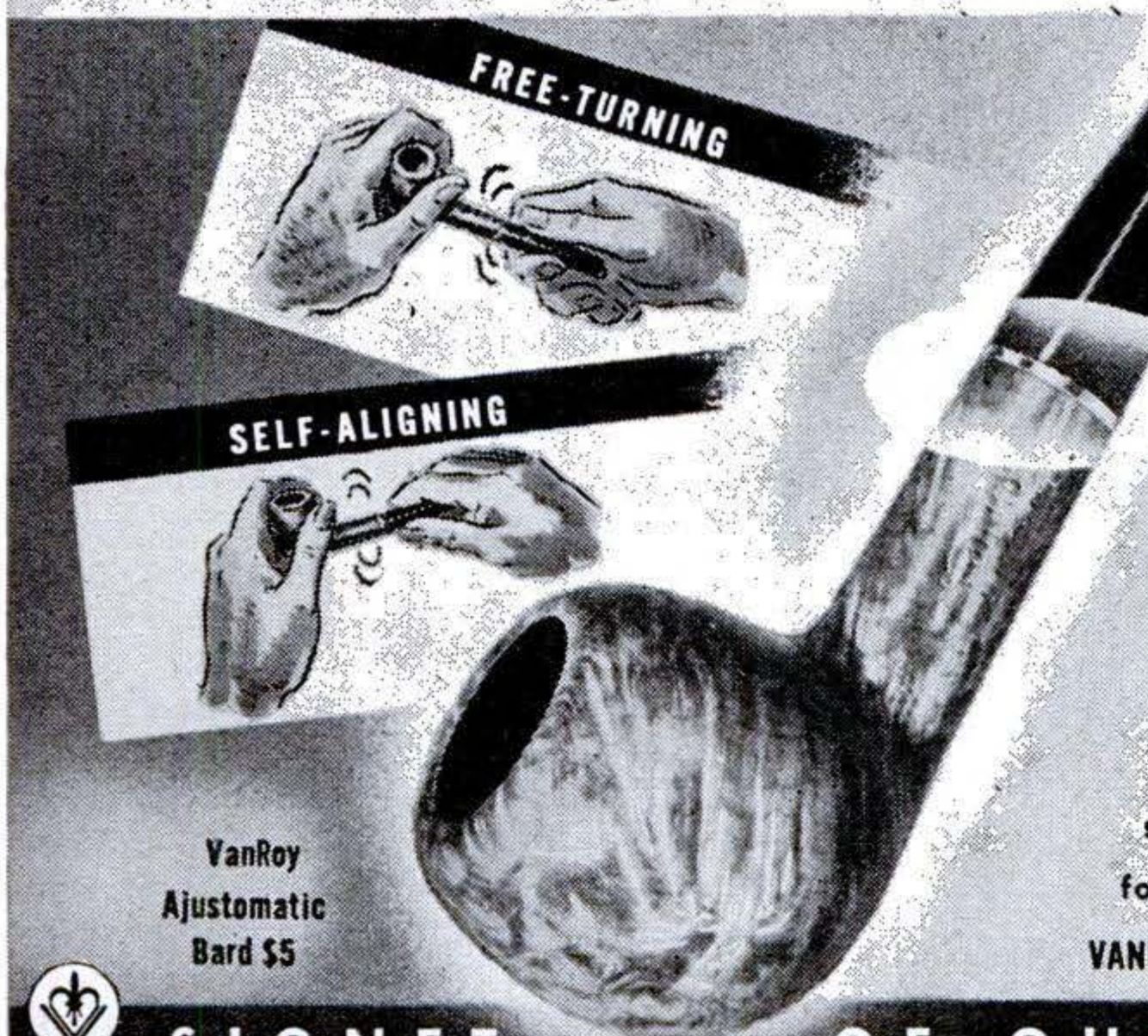
VanRoy Ajustomatic

with the NEW STEM



The one and only Pipe of its Kind

There is nothing in screw-stem pipes like the VanRoy Ajustomatic! With this new kind of pipe the stem can't lock at an off-angle—can't freeze out of line . . . That's because the patented stem is "float-mounted". It can be turned repeatedly yet stem and bowl hold their precision alignment for the life of the pipe . . . Take a turn for the better in a screw-stem—get the VanRoy Ajustomatic pipe for permanent smoking contentment. . . .

VanRoy Ajustomatic Bard $5

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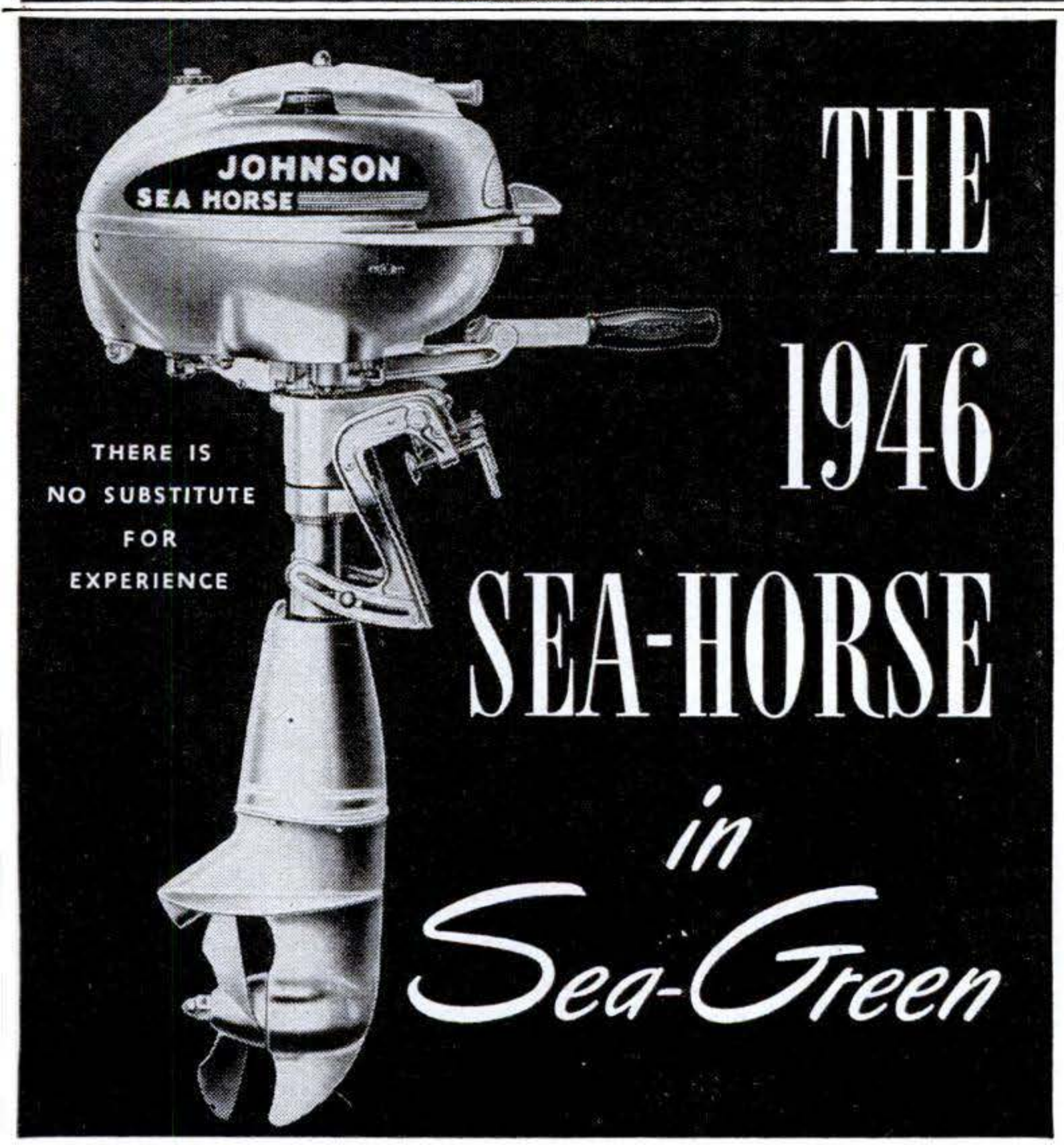
SIGNET OF QUALITY IN PIPES



THERE IS NO SUBSTITUTE FOR EXPERIENCE

THE 1946 SEA-HORSE *in Sea-Green*

This is the motor that *experience* built—the finest in Johnson history. Sparkling in performance, DEPENDable in operation and more beautiful than ever in appearance! Shipments to dealers are being made now. *Full* production schedules should be reached soon. Look for the name of your Johnson Dealer under Outboard Motors in your classified phone book. See him. In the meantime write for a copy of the new Sea-Horse Handy Chart, with illustrations, features and specifications.

JOHNSON MOTORS
500 Pershing Road, Waukegan, Illinois

FIVE GREAT MODELS

Small Alternate Firing Twin . 2.5 H.P.
Medium Alternate Firing Twin . 5 H.P.
Large Alternate Firing Twin . 9.8 H.P.
Super Alternate Firing Twin . 16 H.P.
Heavy Duty Opposed Twin . 22 H.P.

All H.P. ratings are O.B.C. Certified Brake Horsepower at 4000 r. p. m.

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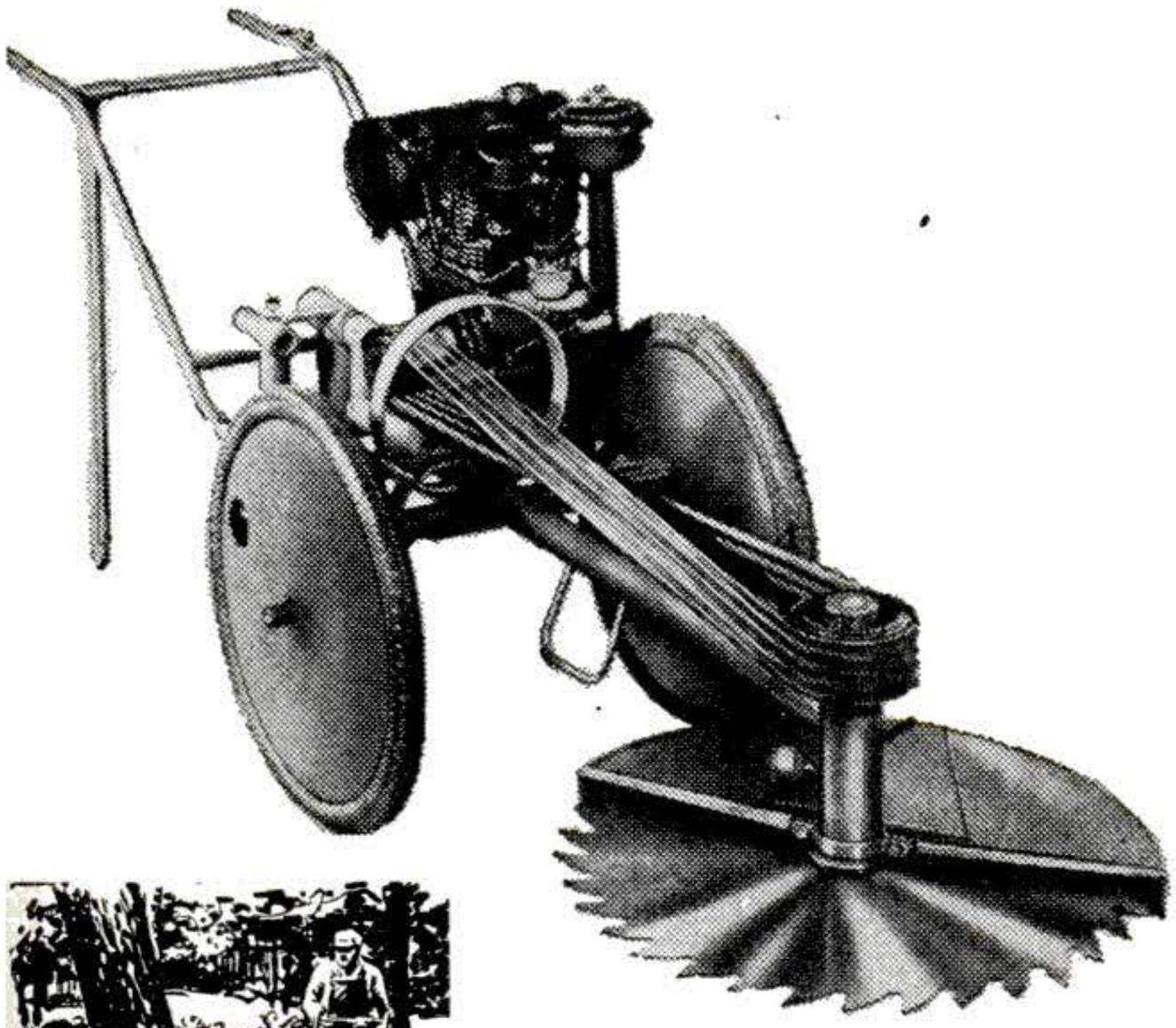

FELLING TREES

30" Oak felled in two minutes and fifty-two seconds with the Lowther C-Saw—11" Pine in fifteen seconds.

CUTTING LOGS

Cutting 10 to 20 cords of wood a day—on only 3 gallons of gasoline.

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Transforms brush covered wasteland into valuable pasture — Quickly and Easily.

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J. A. Best of Mountain Grove, Missouri, says of the Lowther C-Saw: "We have cut everything from Blue Grass to 30" Oak Trees and still say this saw will do more than you claim for it." Write us now! Get full information and learn of the many farm uses of this amazing new saw. $349.50 F.O.B. Factory.

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Today there is a crying demand for cut wood. Highest prices are being paid—get into this healthful, pleasant outdoor work and be your own boss—there's big money waiting for you when you own a Lowther C-Saw.

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Geologists Had Answers To Military Questions

WHEN Nazi camoufleurs had hidden the famous Ploesti oil center in Rumania so thoroughly that our bombers couldn't find it, American geologists put the finger on that primary strategic target by making a new kind of map called a terrain diagram. From their detailed knowledge of Rumanian terrain and of the rock and soil formations under its surface, they were able to show fliers what the hills and fields surrounding Ploesti looked like. Taking their bearings on this map, the aerial raiders made a second trip—and dropped their calling cards right on the tray.

Geologists were able to help American fighters on all fronts during World War II by quickly supplying answers to such questions as these: Where were the best sites for airfields on the Solomon Islands? What kind of terrain would ground forces have to fight over in Madagascar? What camouflage equipment should be taken to Sicily?

By telling engineers whether the soil before them was soft or rocky, geologists made it possible for them to know how many bulldozers to take along and how much dynamite to carry for blasting. Drainage and sources of water were other important problems which geological knowledge helped the first working crews to solve with a minimum of time and effort.

Brighter, Clearer Images Seen in Television Show

A NEW cathode-ray tube for television sets, providing a much brighter and clearer image than any prewar model, has been developed by engineers of the Radio Corporation of America. The tube was recently demonstrated at a television show in which images in color and apparently in three dimensions were also projected on a screen.

RCA's new cathode-ray tube provides a brighter and clearer picture because of a microscopically thin screen of aluminum that is attached to the phosphorous-treated side of the tube. Electrons are shot at this aluminum screen with such speed that they pass through it and hit the phosphor granules, causing the picture to be made at the end of the tube. Some of the light generated tries to pass back into the tube, but hits the aluminum screen and is mirrored out again. The aluminum is so close to the phosphor that there is no time lapse and none of the light is lost. This provides greater clarity and brightness in the picture.

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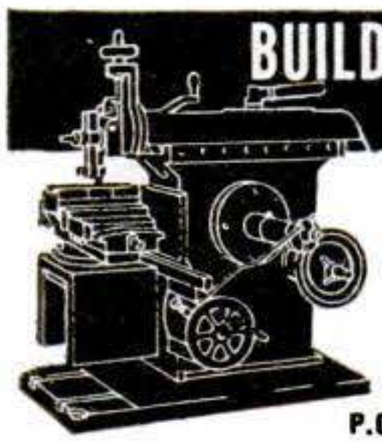

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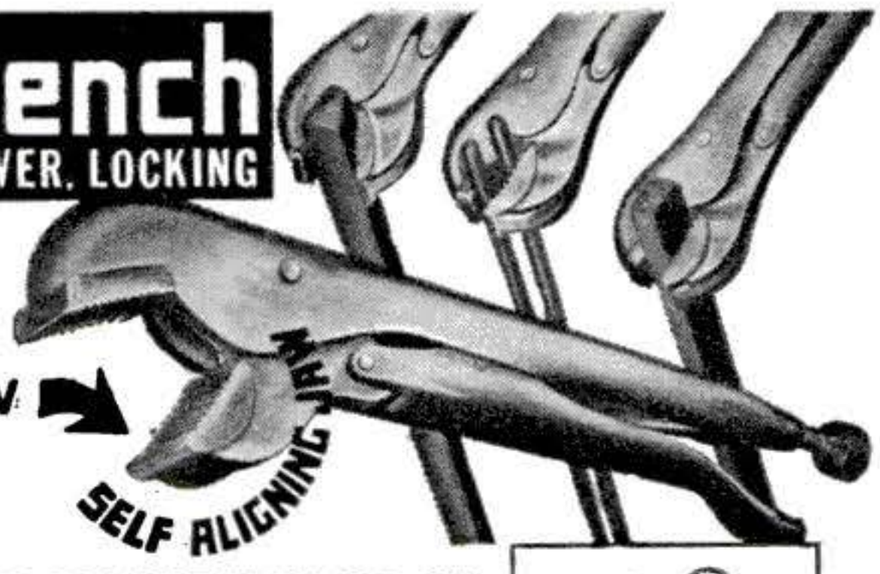

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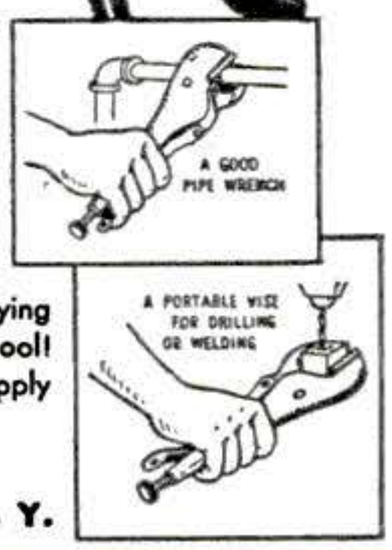
LOCKS WORK WITH *TONS* OF PRESSURE . . . HANDS FREE



This remarkable brand-new tool is a combination pliers, wrench, pipe wrench, clamp and hand vise. The self-aligning jaw fits itself to irregular shaped objects, giving a powerful, jaw-length grip, multiplying hand pressure at least fifty times. A whale of a tool! OPA ceiling price $2.45. If your dealer cannot supply you, order direct.

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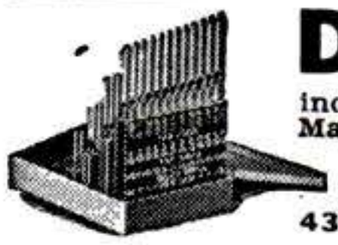

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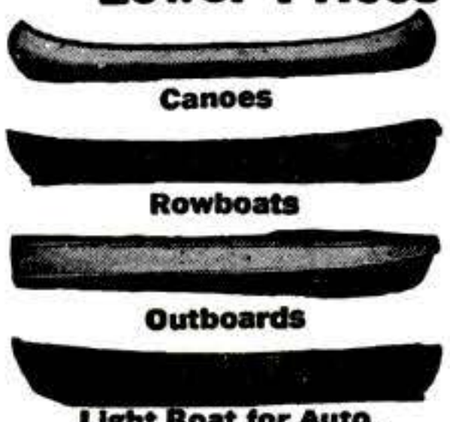

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Grueling Three-Day Tests Screened Secret Agents

MEN who were courageous, resourceful, and strong enough to be sent into enemy territory on hazardous undercover missions for the Office of Strategic Services during World War II were chosen in grueling three-day tests.

Candidates for supersecret assignments were subjected to Nazi-style cross-examination under blinding lights, had to run a difficult obstacle course, were given novel intelligence tests, were allowed to drink hard liquor and then questioned under its influence to see if their loosened tongues wagged too freely.

The jobs they were to do ranged from parachuting into enemy country to sabotage communications, supply lines, and industry, to writing propaganda leaflets in the comparative safety of London under a rain of Nazi bombs. One out of every five tested was "not recommended" for overseas service. Another one out of five did not succeed in going for other reasons. But, of those who passed the stiff tests satisfactorily, only about six out of 100 failed to make good.

During the three-day test period, the candidates, in groups of 18, lived on a country estate outside Washington and associated day and night with the psychologists, psychiatrists, and sociologists who were their examiners. But the candidates arrived with fictitious names and dressed in disguising Army fatigue uniforms. No one knew whether his neighbor was a general, a private, or a civilian—and all were included among those tested.

Among the unusual tests designed to "assess the whole person" was the psychodrama, now being used widely for training and therapy among the mentally and emotionally ill. The candidates were put on a stage to enact a drama, but instead of being given fixed parts to learn they were placed in a prearranged situation and had to make up their own lines as each worked out his own idea of the best approach to the situation.

There was also a "brook test," in which candidates were taken to a brook on the estate and told they had to move a heavy but very delicate instrument across it alone with only the aid of some boards, rope, and tackle that lay on the ground. In another test each man was told to assume he had been caught going through secret documents and was explaining to enemy officials. This was followed by the nerve-wracking cross-examination under lights.

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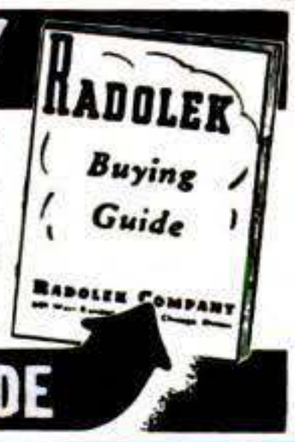

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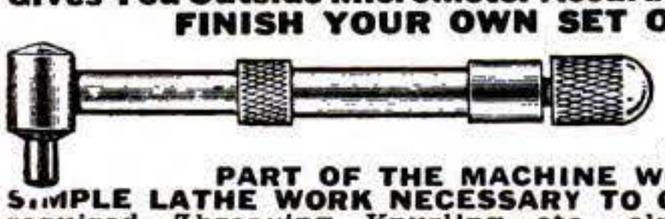

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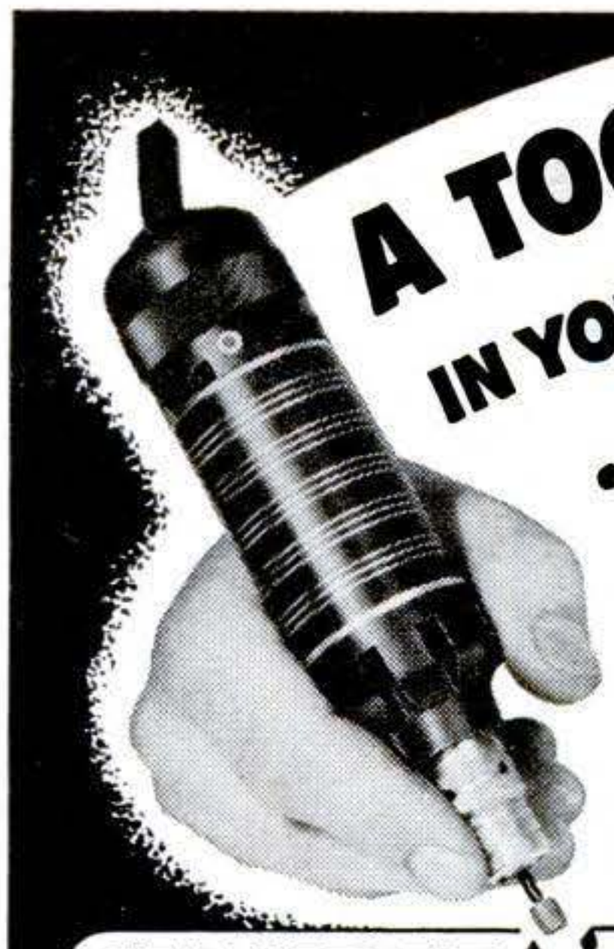

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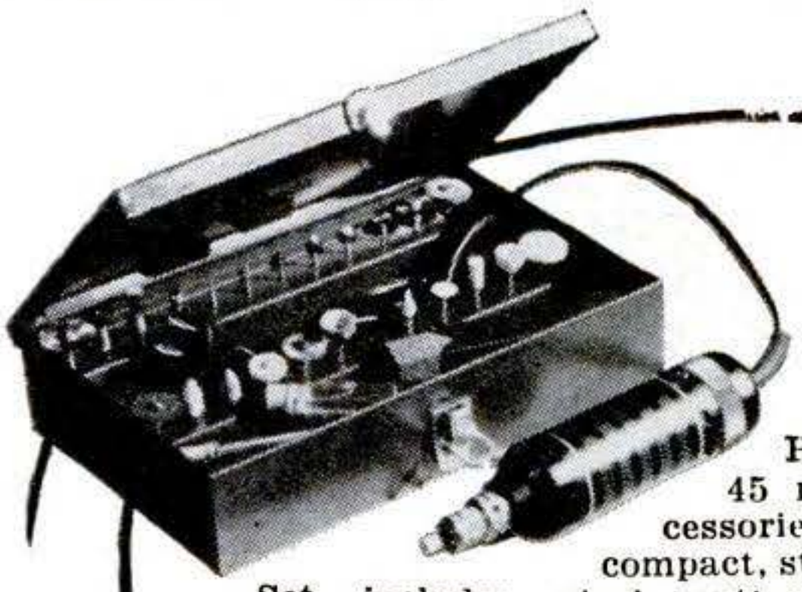

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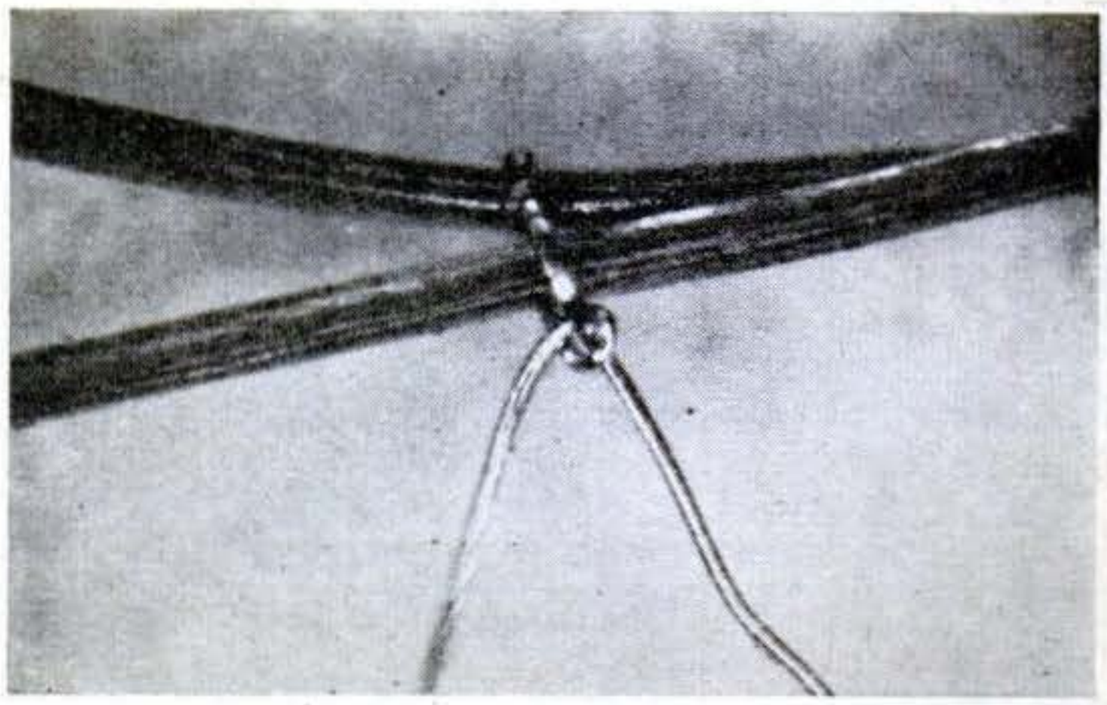

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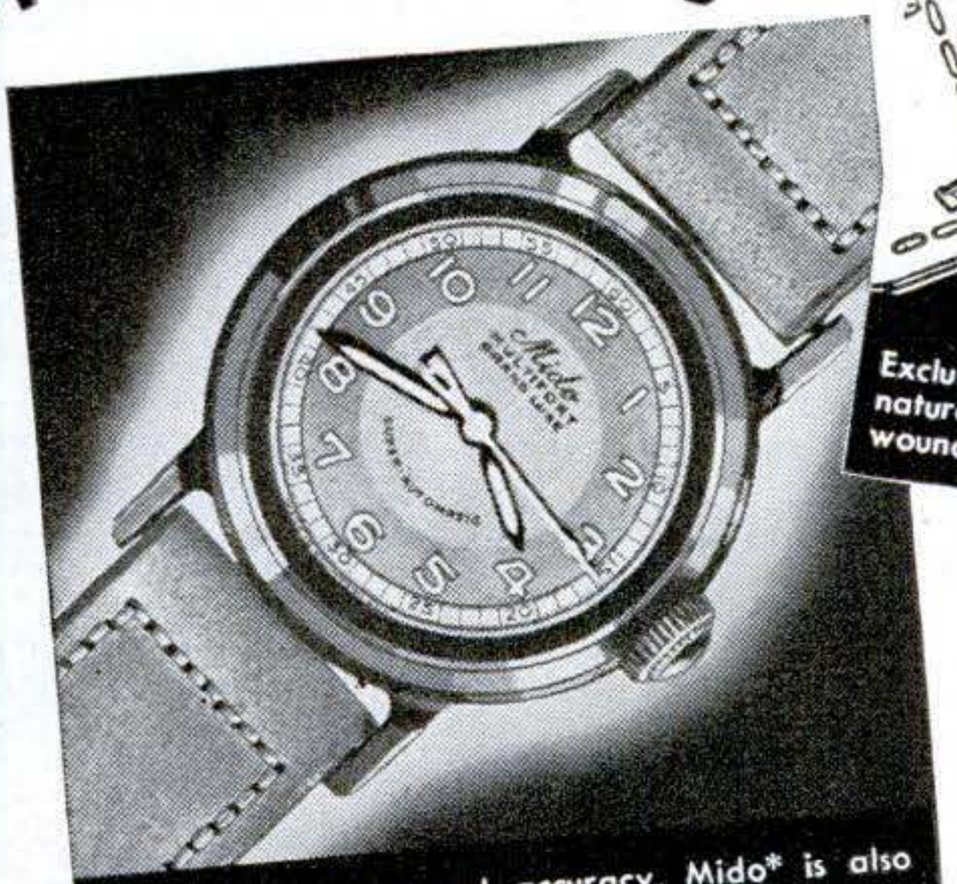

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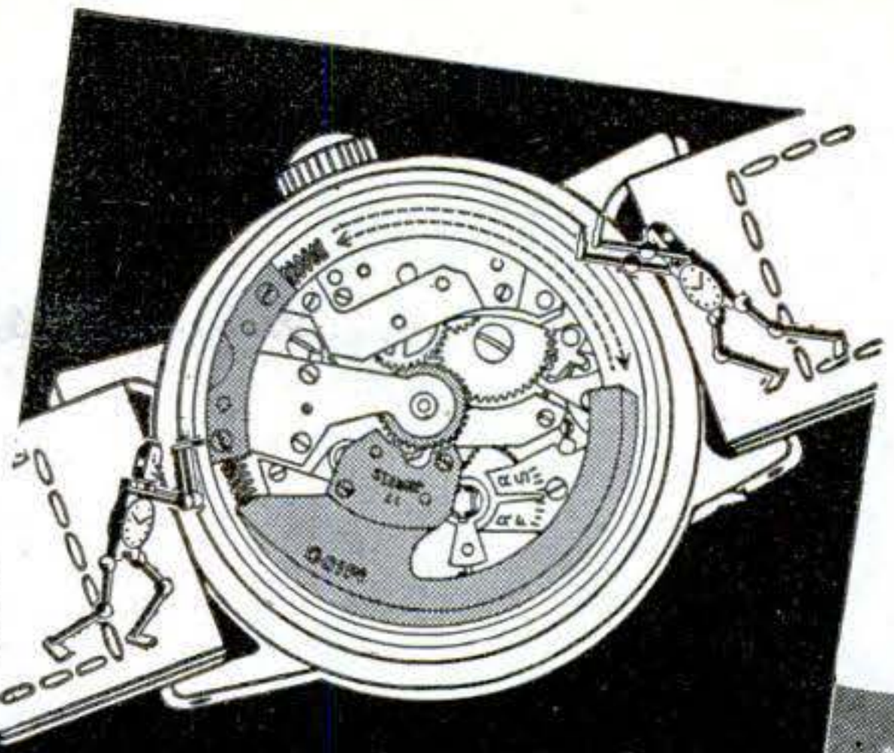

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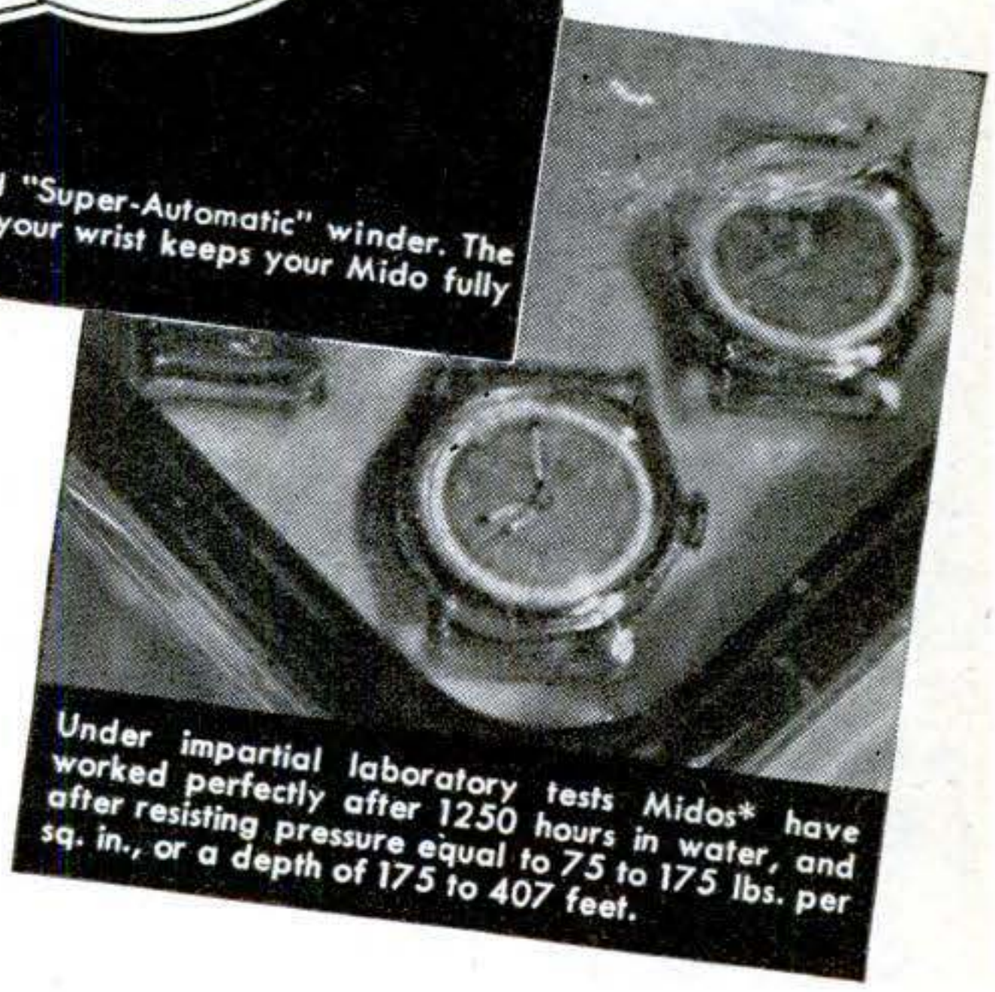

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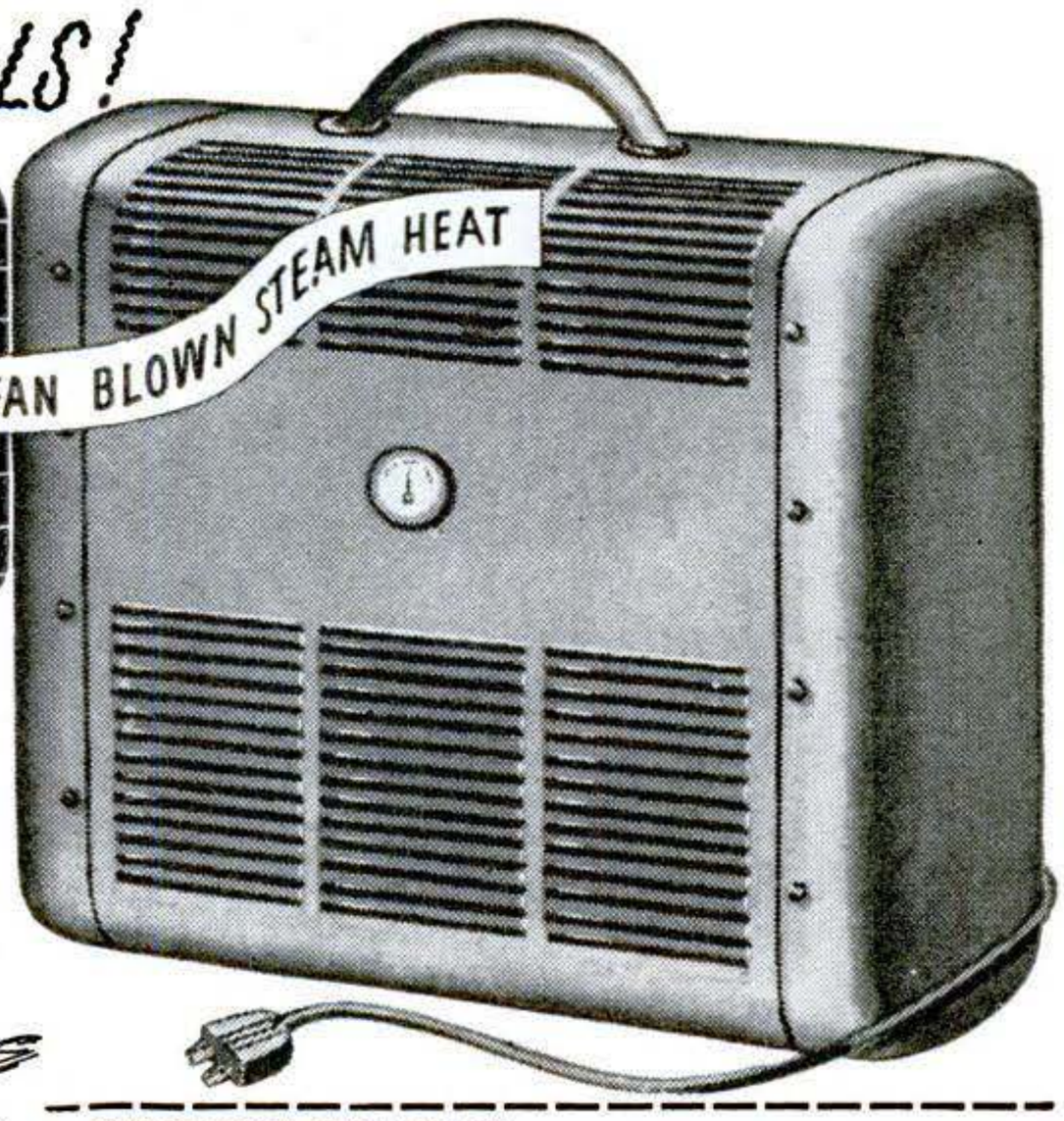

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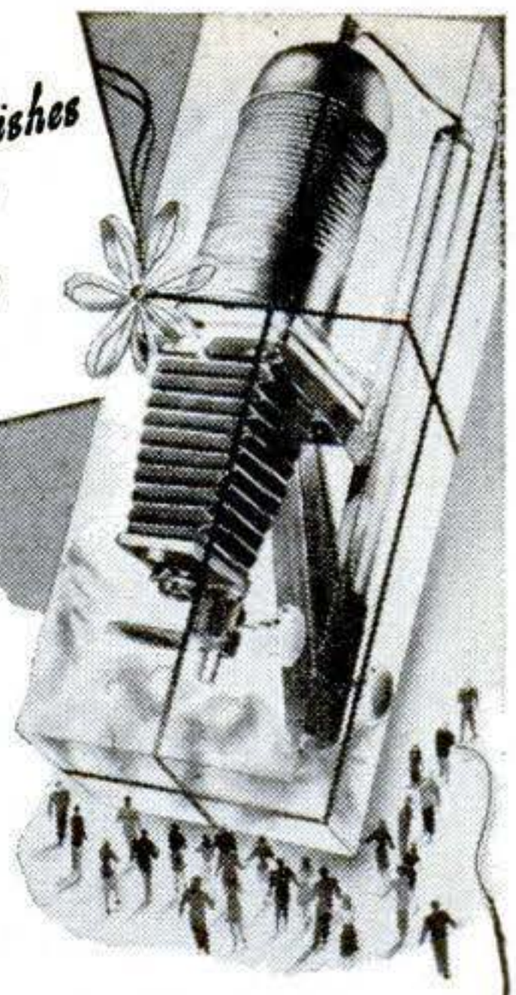

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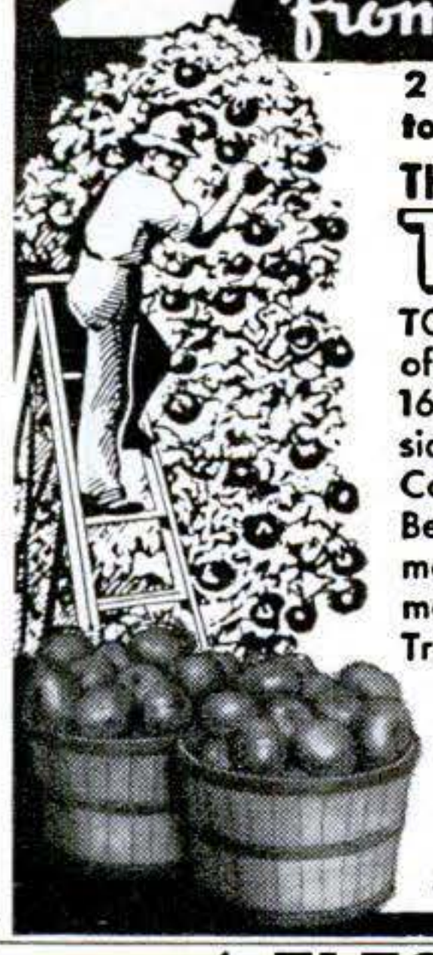

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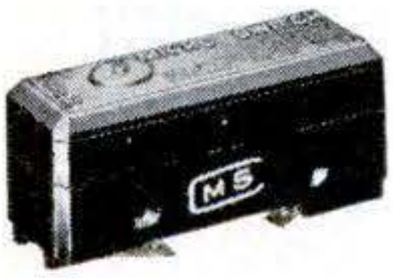

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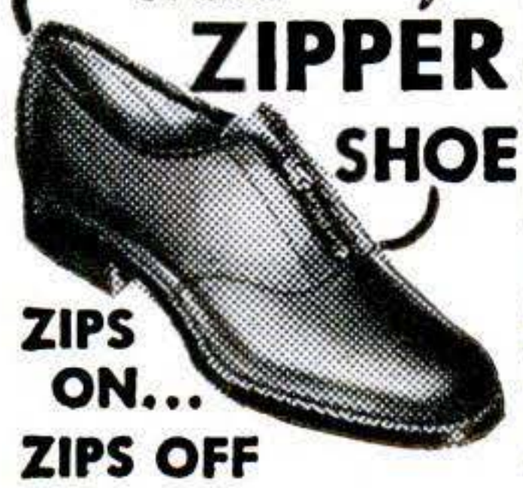

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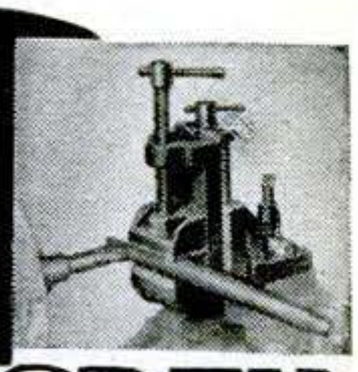

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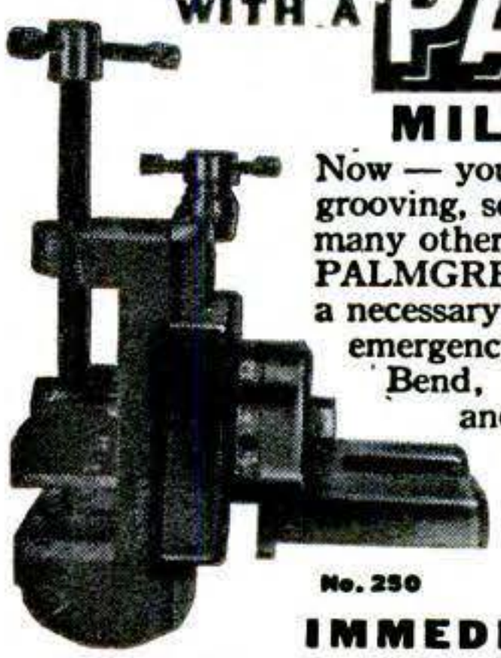

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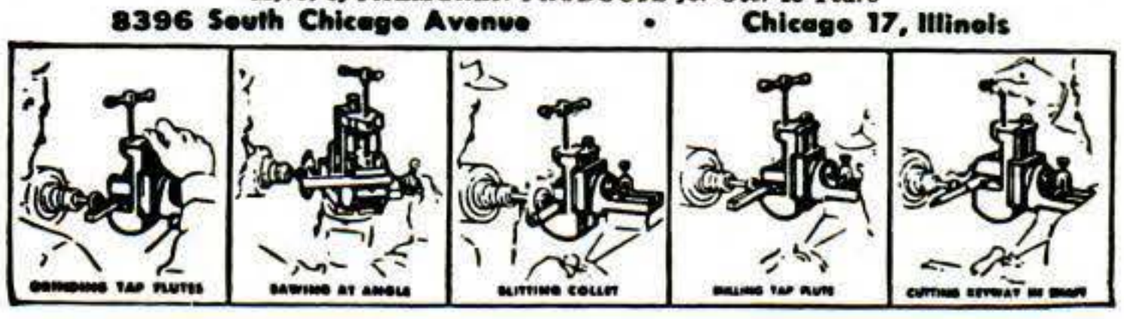

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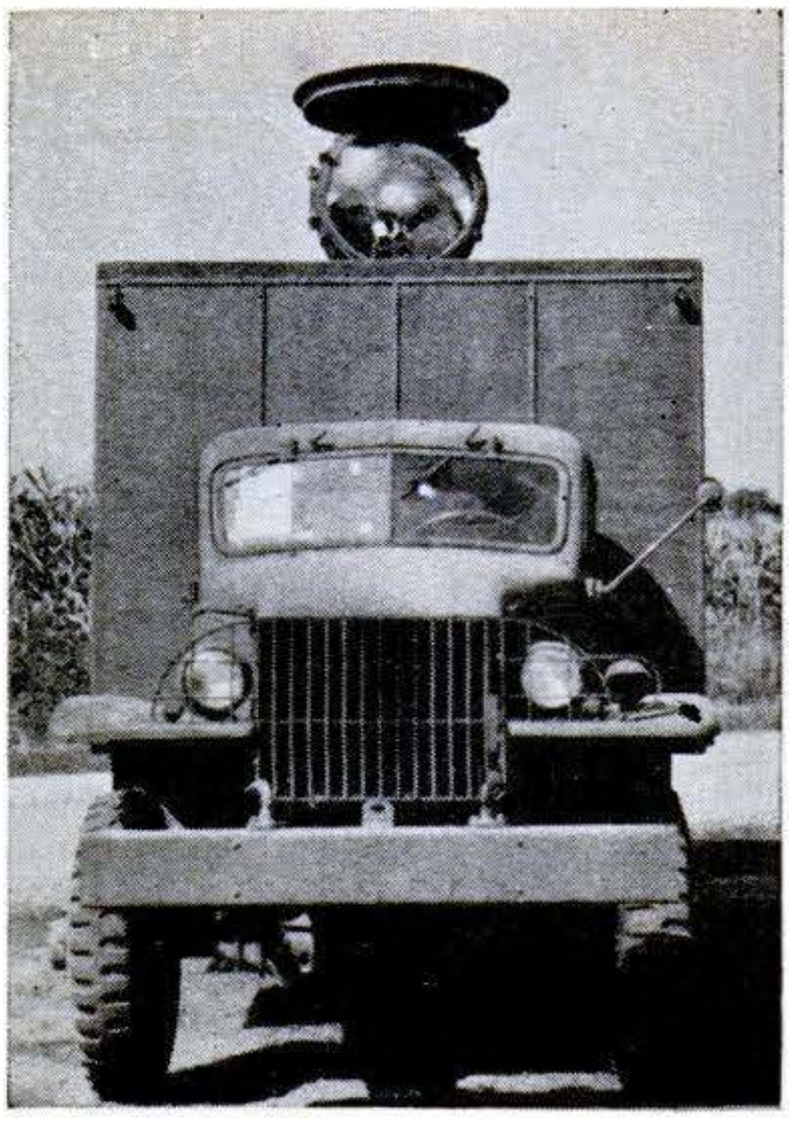
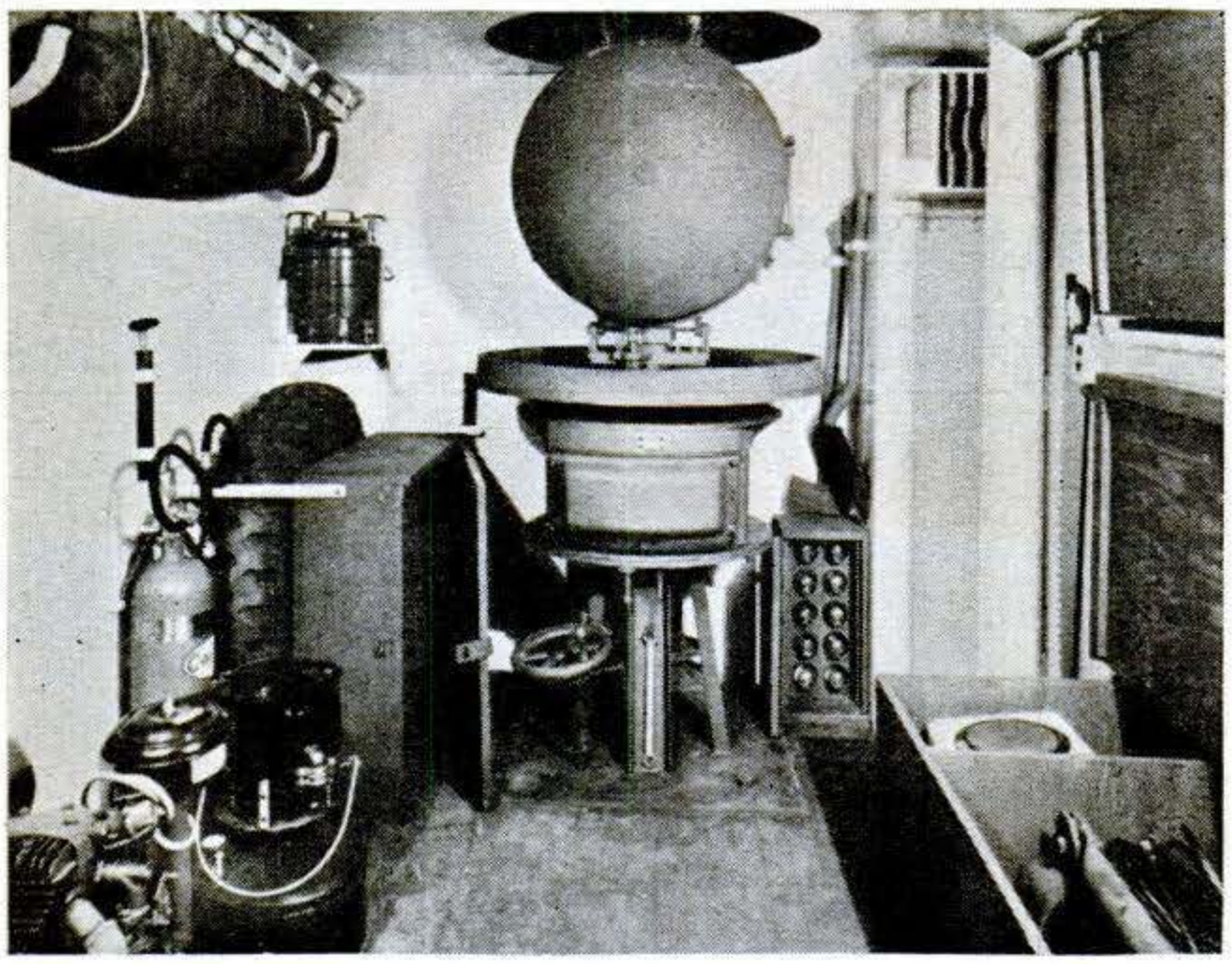
MANY-PURPOSE LIGHT TRAVELS BY TRUCK

A PORTABLE, mobile, rotating beacon is being manufactured by the Davy Compressor Co., Kent, Ohio, for the U. S. Coast Guard. Designed especially as an aid to marine and air navigation, the light has a 24-inch face equipped with various snap-on lenses, shutters, and mountings that adapt it to use as an airport beacon, searchlight, floodlight, temporary lighthouse, or signal. A variable-speed arrangement permits a change in the rotating pattern, and the beacon may also be fixed in position for direction use. By a flasher system it can send messages to planes or ships without radio contact, or it can be rushed to the location of a damaged lighthouse to pinch-hit temporarily. The light, equipment, and the accommodations for a two-man crew are carried from place to place on a 1½-ton truck.



Mounted in a 1½-ton truck, this mobile rotating beacon, shown in raised position, is designed as an aid to marine and aerial navigation in emergencies.



Here is the beacon light in its retracted position inside the truck. At the left is the electric generating plant that supplies the current. The truck also affords space for complete auxiliary equipment, tools, and spare parts. and provides living quarters for a two-man crew. A field telephone permits contact with the operational base. The lift for the light is controlled by a hand wheel that operates elevating gears carried in a support between the truck-frame channels.

The beacon can be removed quickly and easily from the truck and mounted on a tripod for field or other locations where the truck cannot go. A tent measuring eight by 10 feet is part of the equipment, affording a camp setup independent of the truck. This mobile rotating beacon is also adapted to many civilian uses such as motion-picture production and outdoor photography. Installations can also be made in the customer's truck at the factory in order to meet special needs or conditions to which such a light may be adapted.

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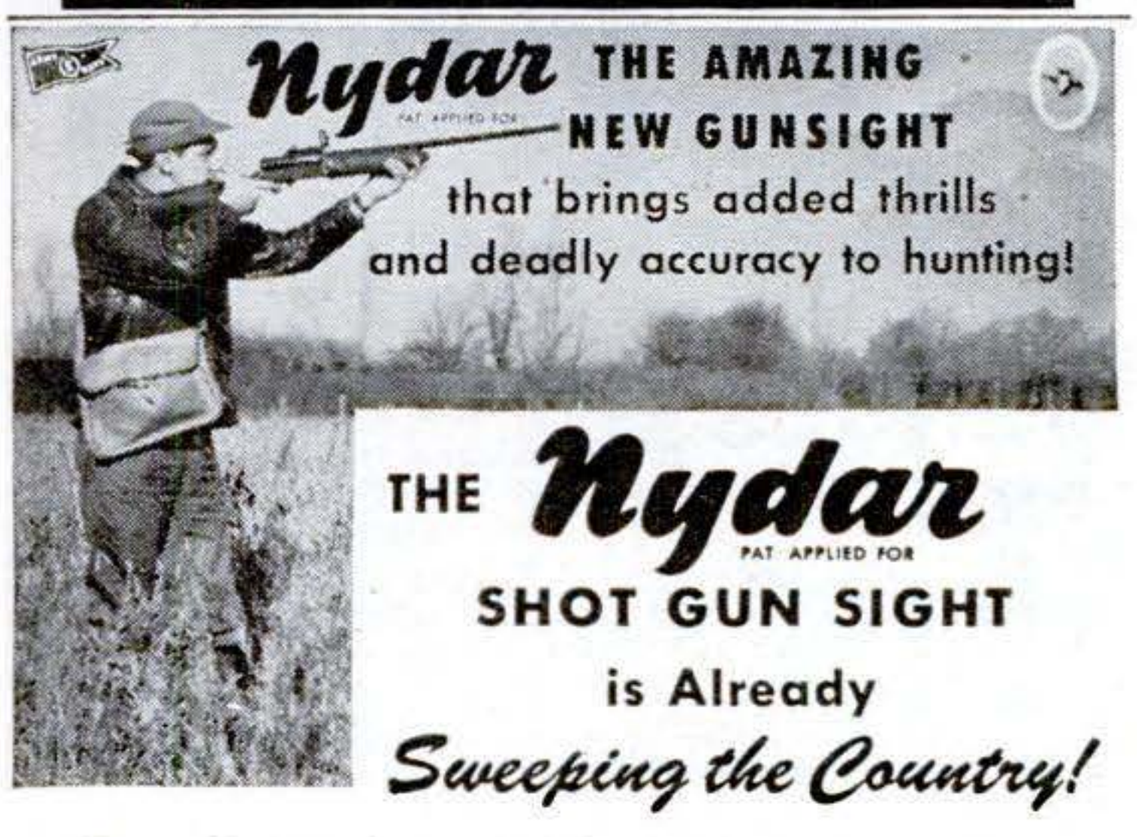

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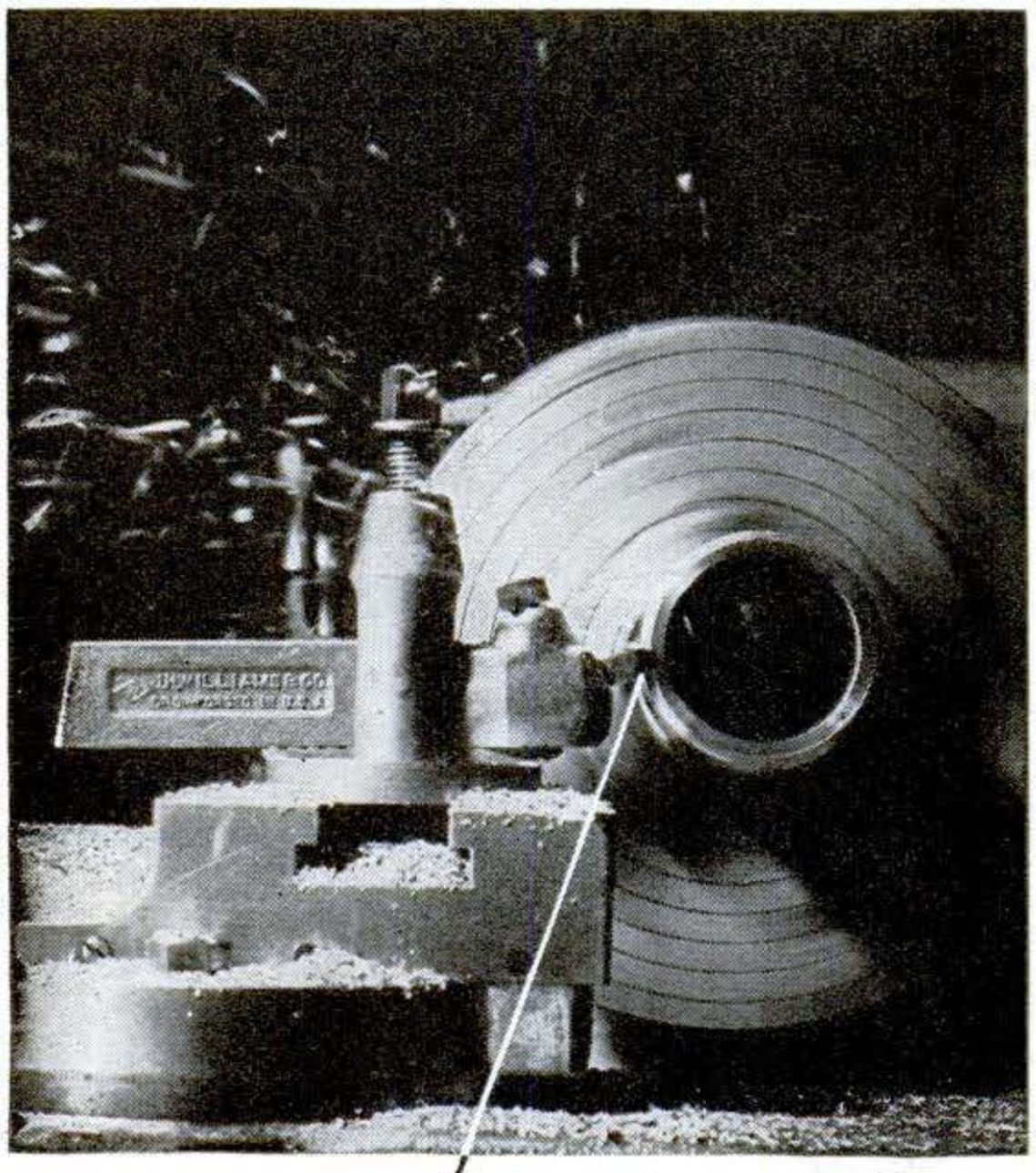

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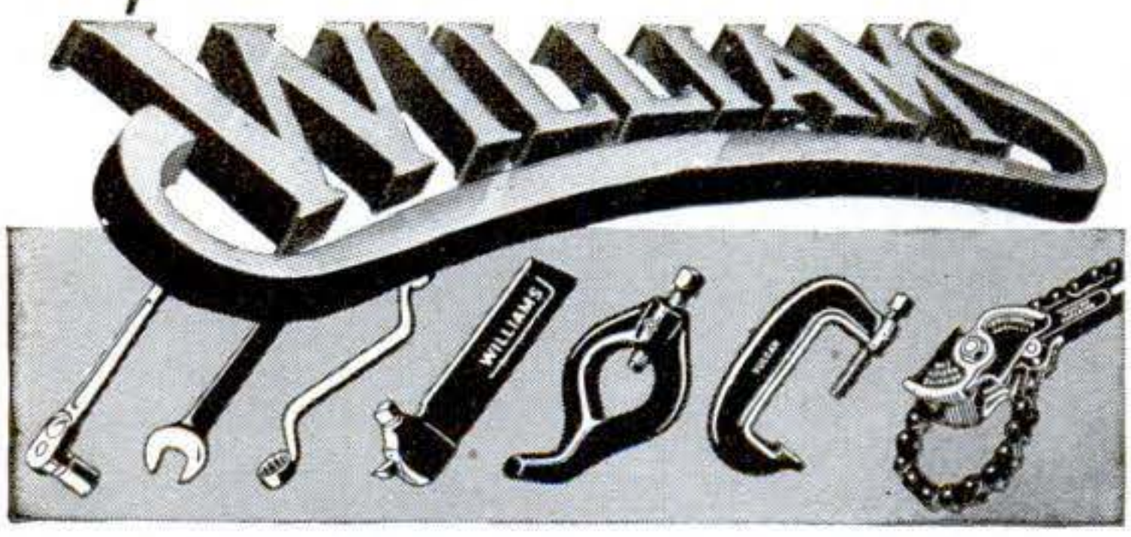

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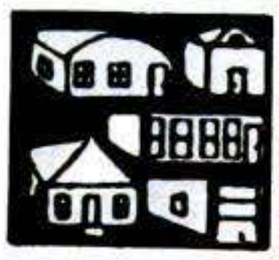

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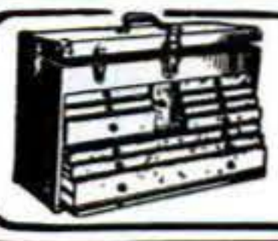

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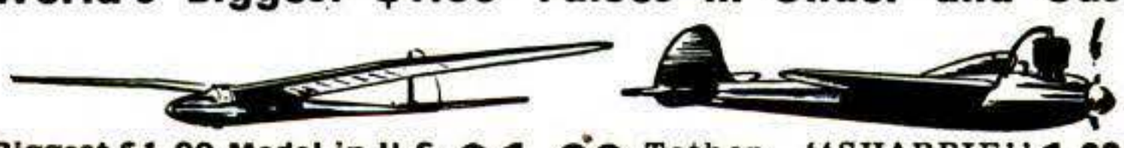

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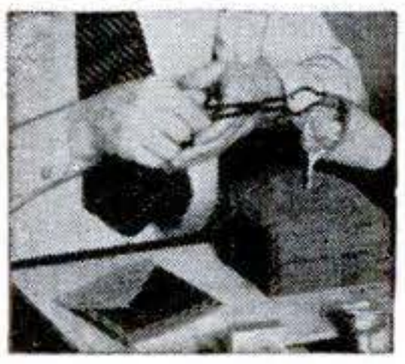

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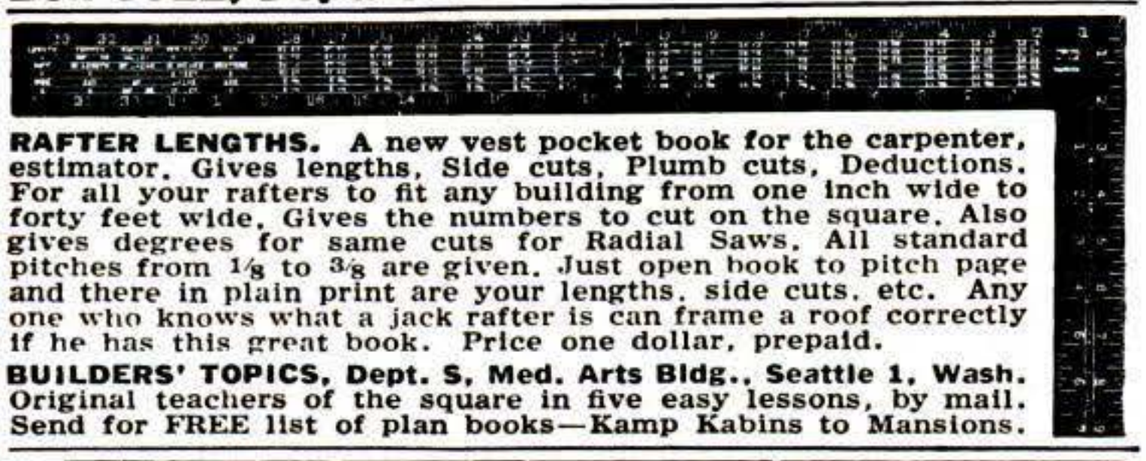

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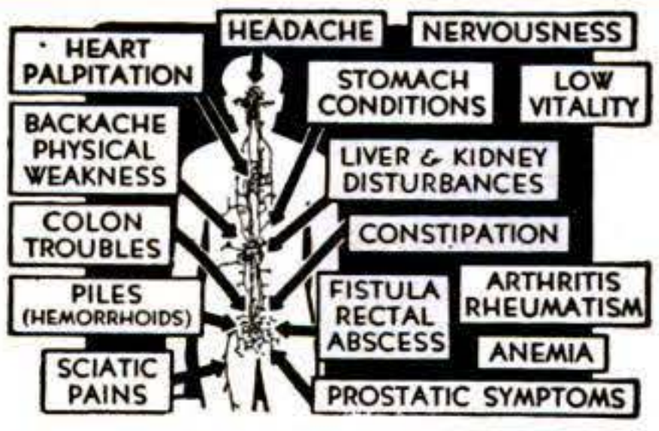

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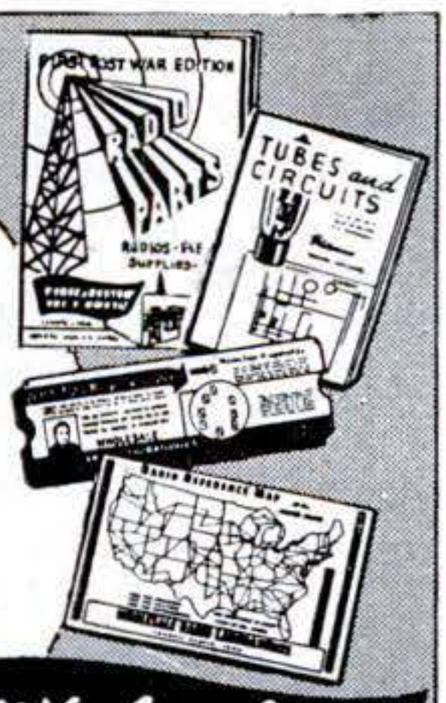

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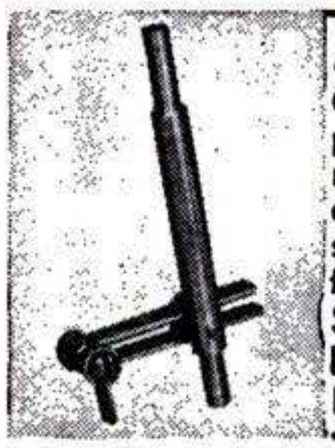

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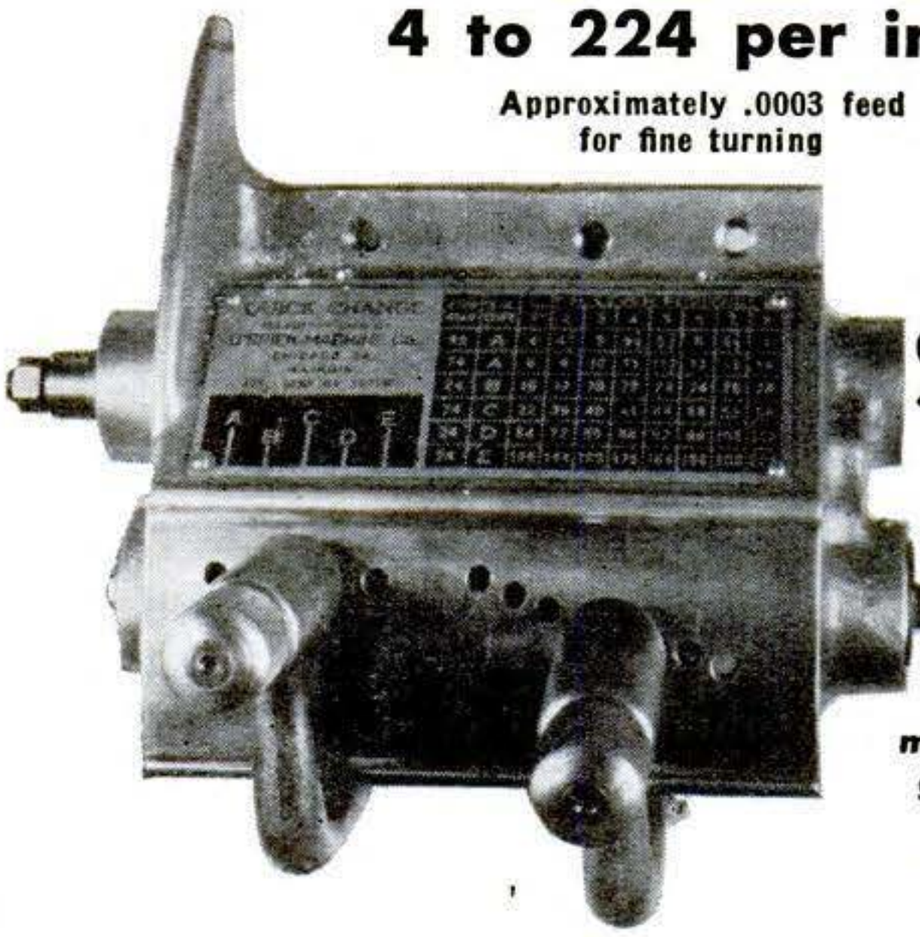

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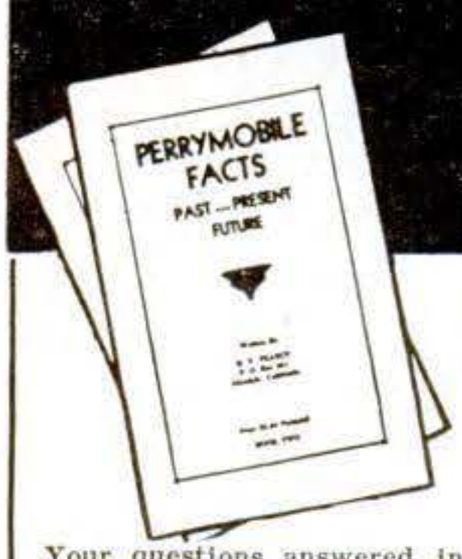

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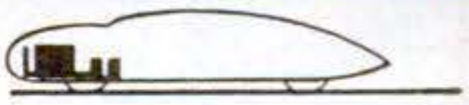

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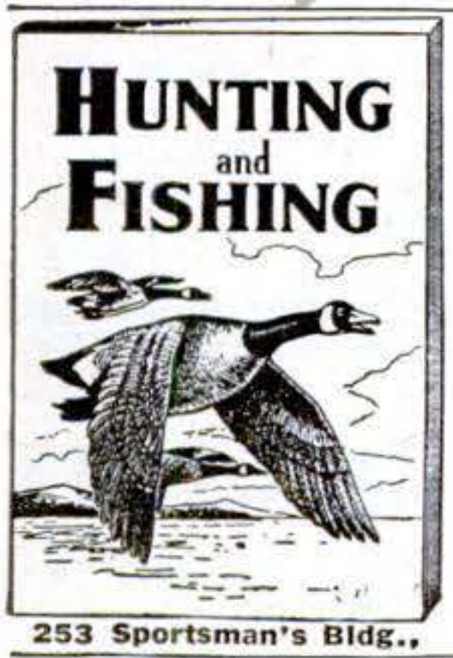

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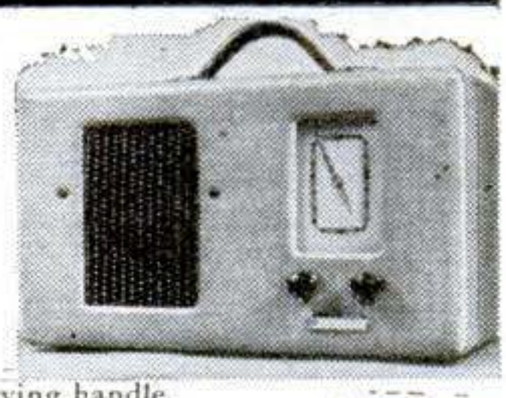

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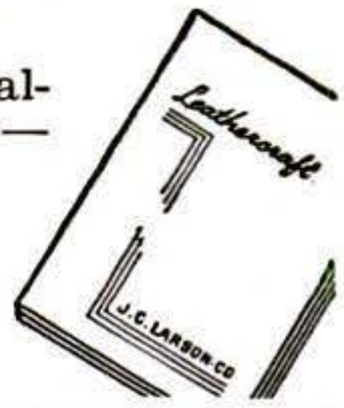

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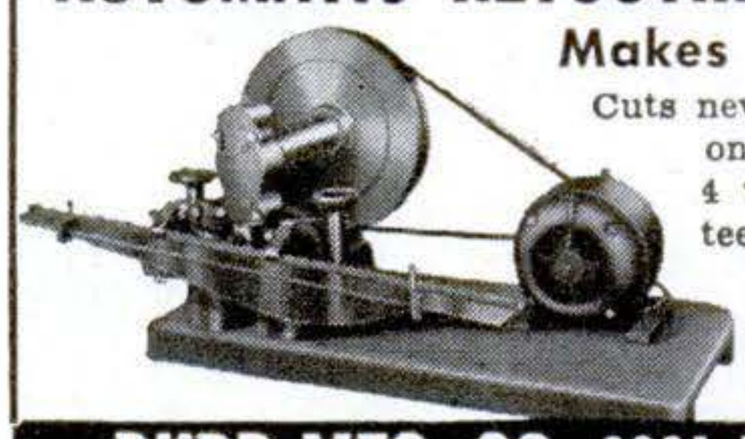

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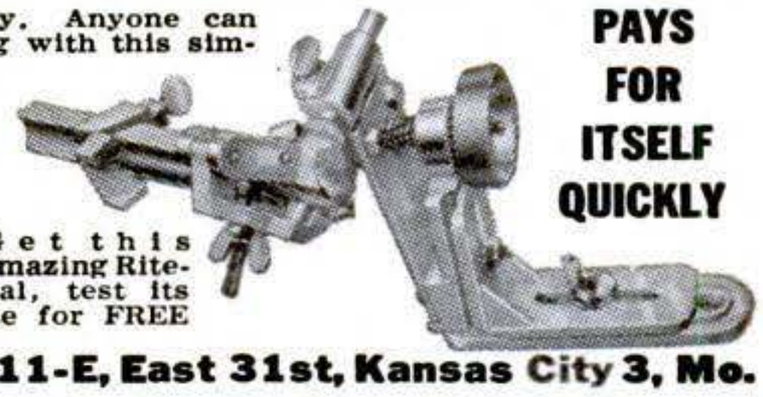

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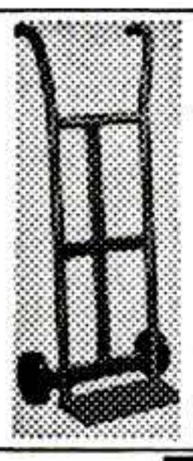

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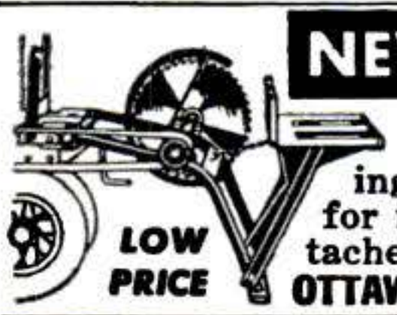

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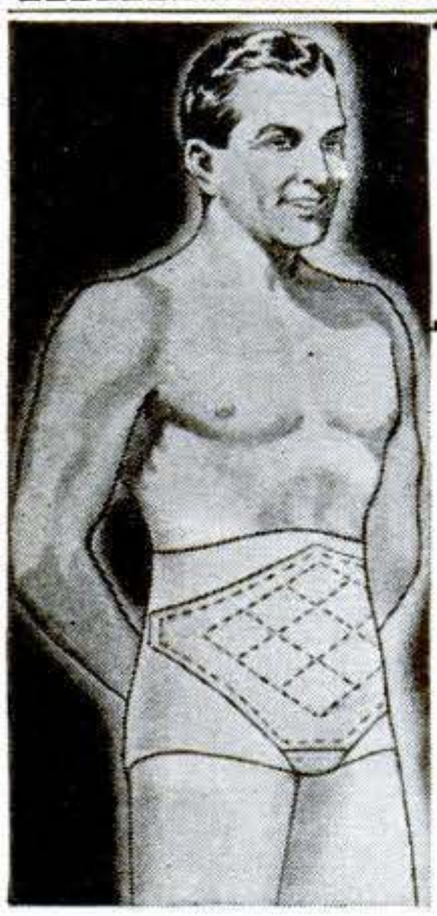

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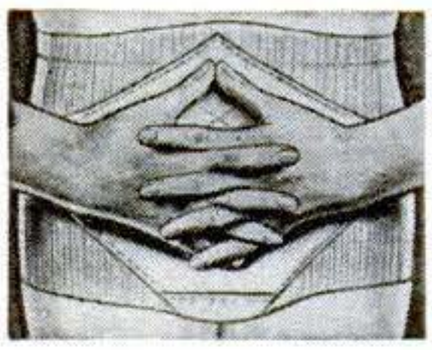

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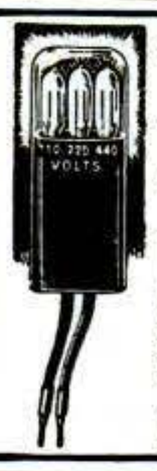

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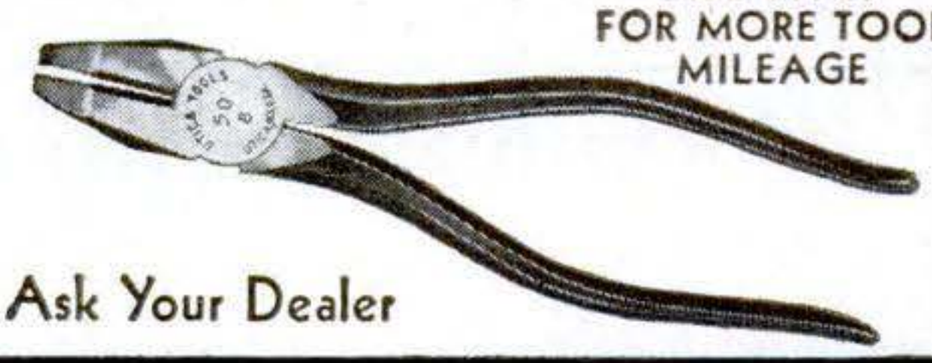

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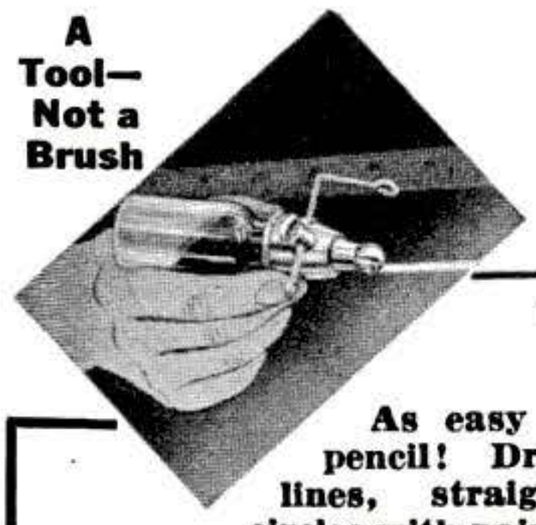

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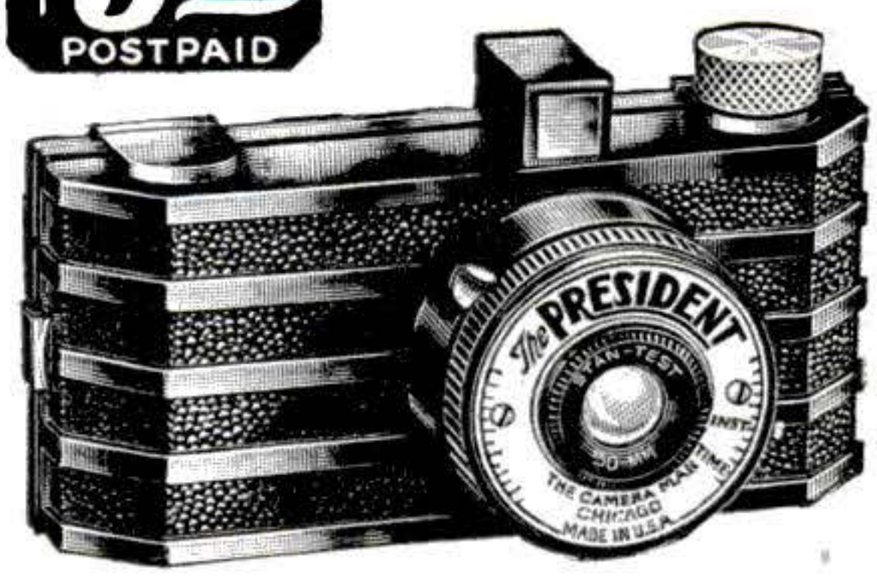

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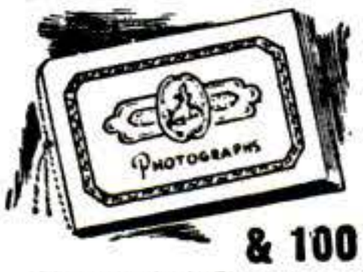

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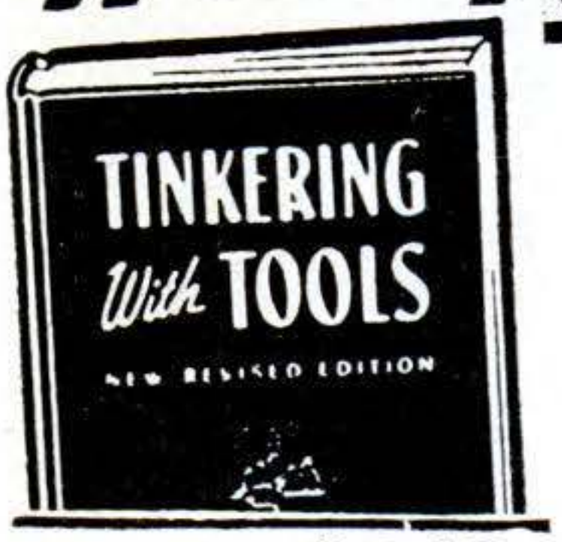

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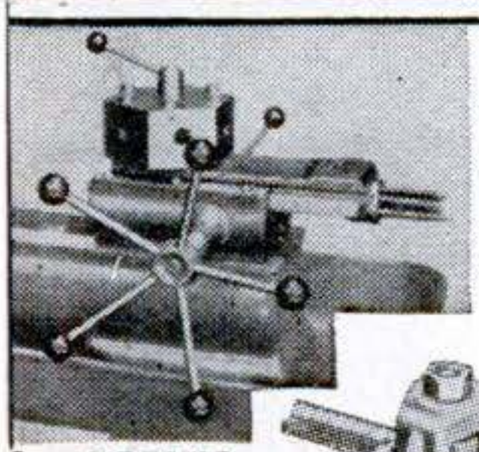

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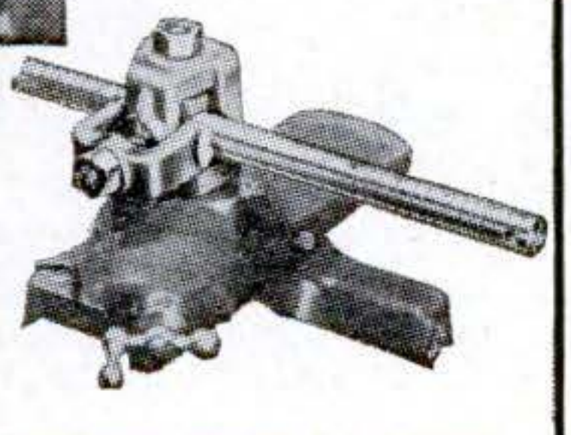

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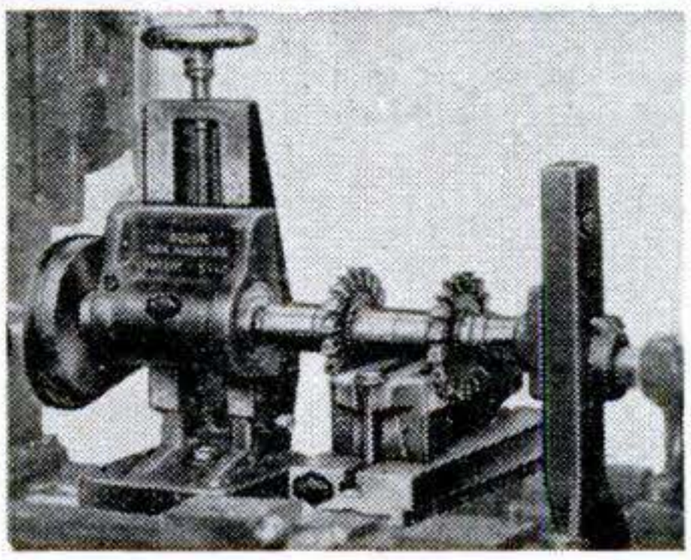

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"This house—I wouldn't swap a shingle off its roof for any other house on earth. This little valley, with the pond down in the hollow at the back, is the spot I like best in all the world.

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" 'Don't do it, John!' she said. '*Please* don't! For the first time in our lives, we're really saving money. It's *wonderful* to know that every single payday we have *more* money put aside! John, if we can only keep up this saving, think what it can mean! Maybe someday you won't have to work. Maybe we can own a home. And oh, how good it would feel to know that we need never worry about money when we're old!'

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"What's more, we kept right on putting our extra cash into U. S. Savings Bonds. And the pay-off is making the world a pretty swell place today!"

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Popular Science Monthly

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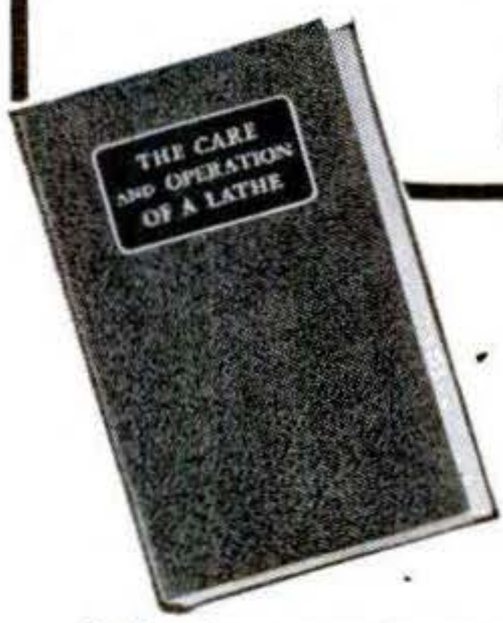
The basic "know how" for the metal-cutting lathe operator



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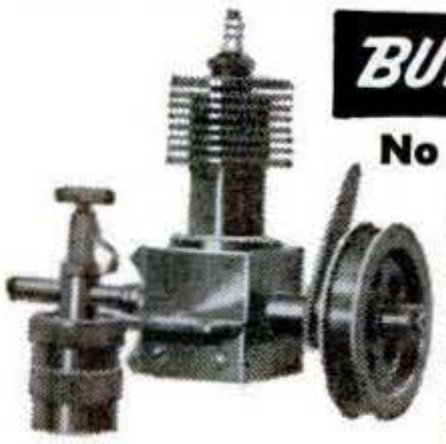

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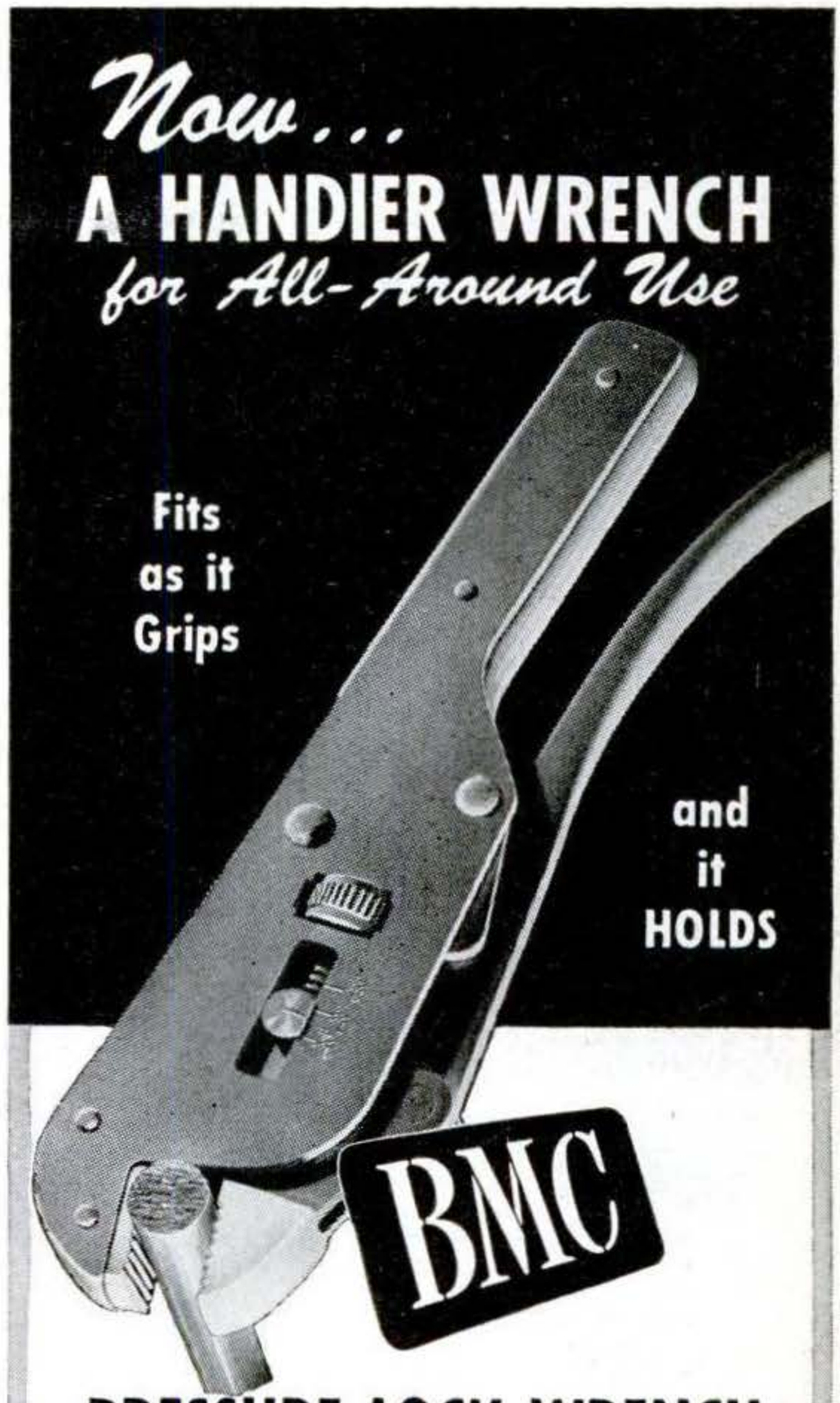

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thousands of uses on nuts, studs, pipe, short, broken or irregular pieces.

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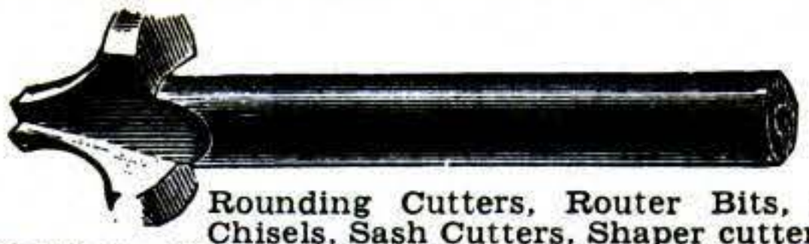

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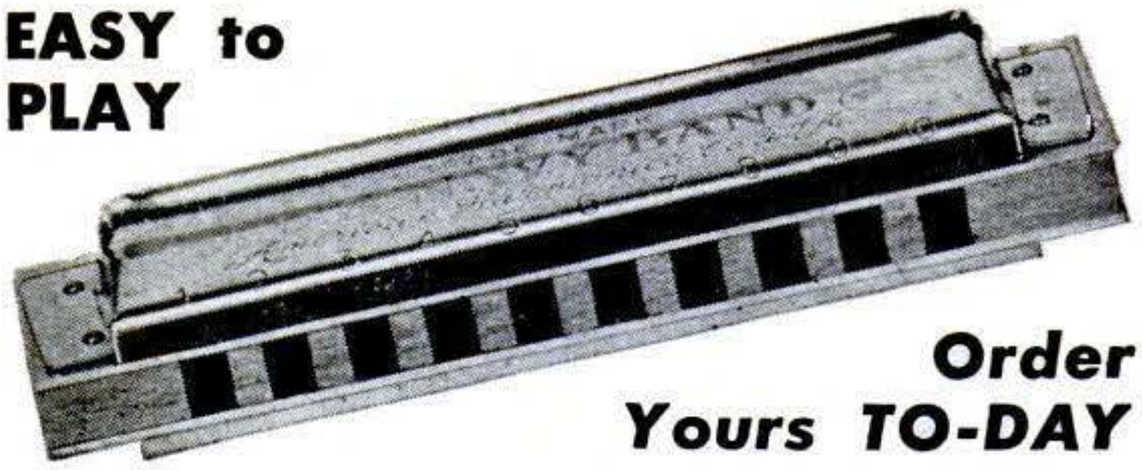

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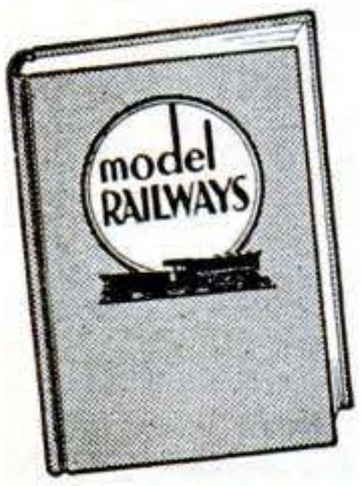

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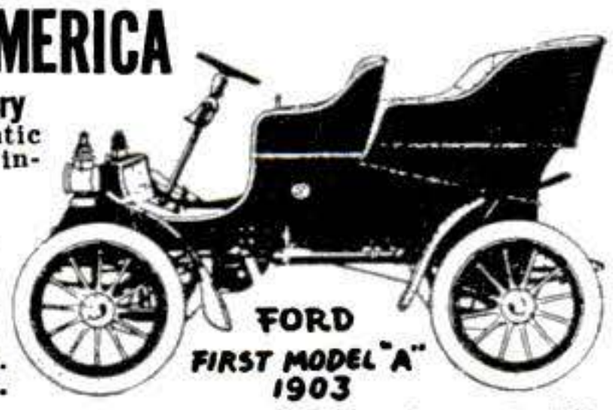

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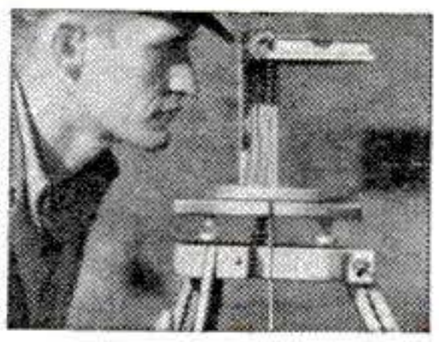

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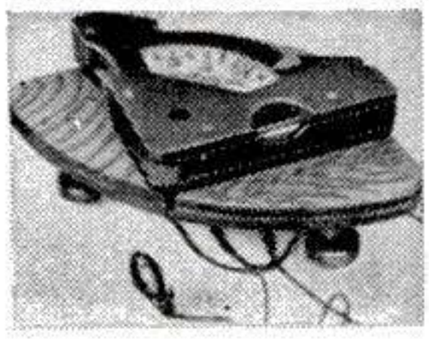

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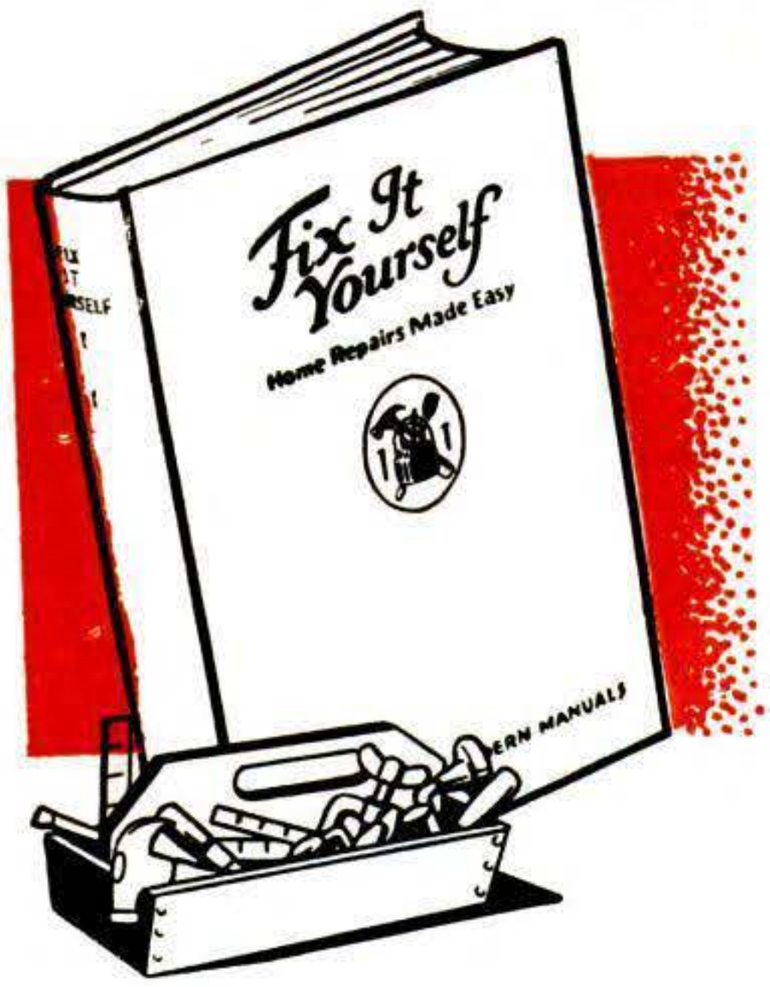

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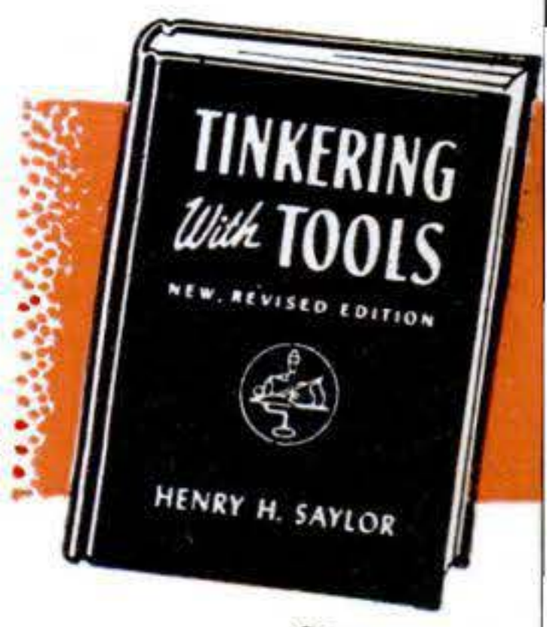

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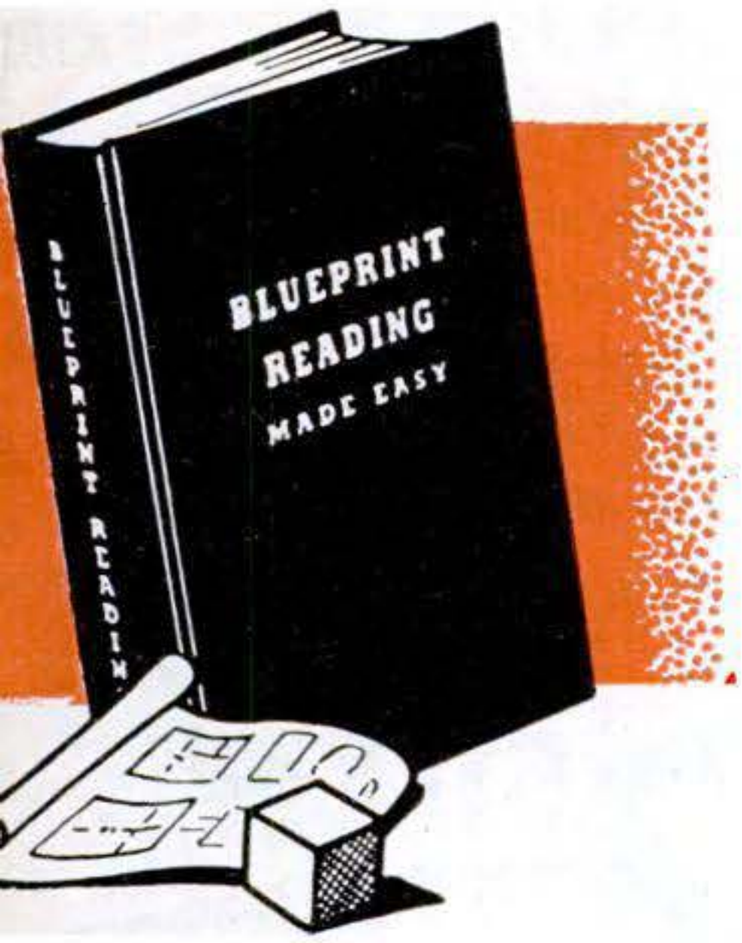

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According to him, this sleeping giant of mind-power, when awakened, can make man capable of surprising accomplishments. It is as amazing as the atom bomb is compared with former sources of energy. Many thousands of people throughout the world have already tried his methods. Many report improvement in power of mind, achievement of brilliant business and professional success. Others report improvement in health, increased strength, courage, poise or energy, or a more magnetic personality.

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As part of a great movement to make his methods available to more people, a 9000-word treatise is offered absolutely free for the time being. It reveals many startling results. Readers of this announcement can get their free copy by sending a post card or letter to the Institute of Mentalphysics, 213 S. Hobart Blvd., Dept. W-509, Los Angeles 4, Calif. Readers are urged to write promptly, because this offer may be withdrawn at any time. Adv.

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MODEL 2 Illustrated

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Now that priorities have been lifted, Moto-Tool can work for you. Moto-Tool owners daily discover new jobs that can be done more expertly in less time. In fact, new purchasers find dozens of uses in addition to those they had in mind. So great is the saving of time and labor with Moto-Tools, thousands of mechanics and craftsmen would find it difficult to get along without their "mighty little midgets."

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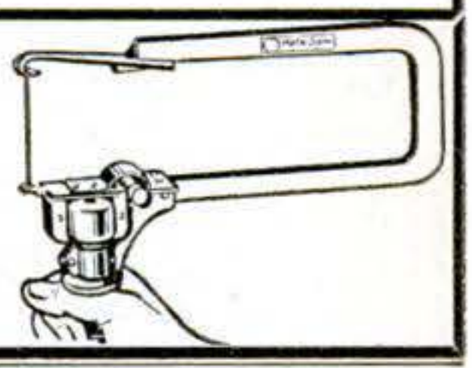

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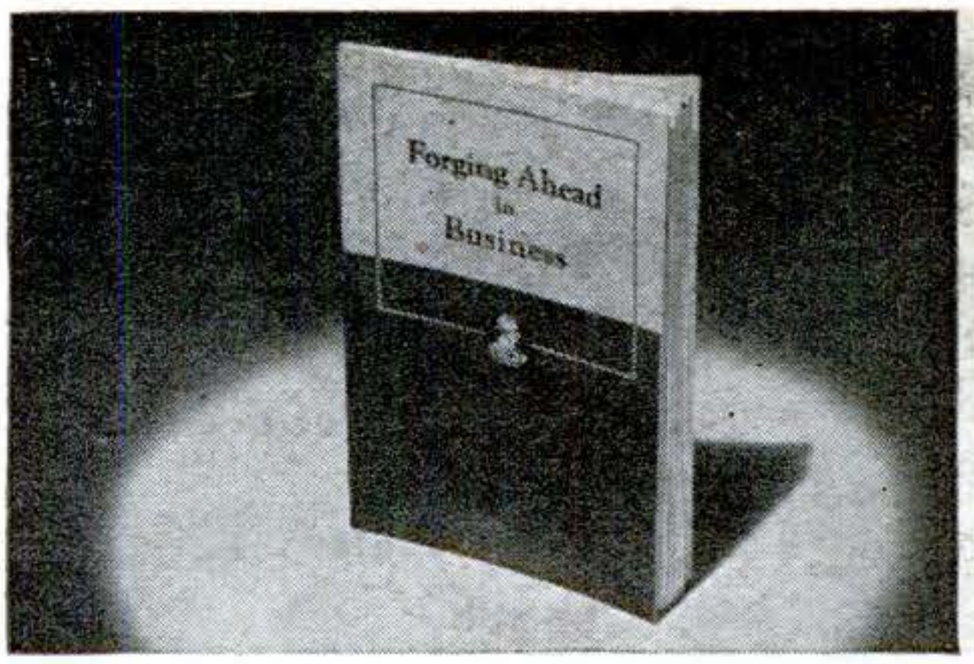

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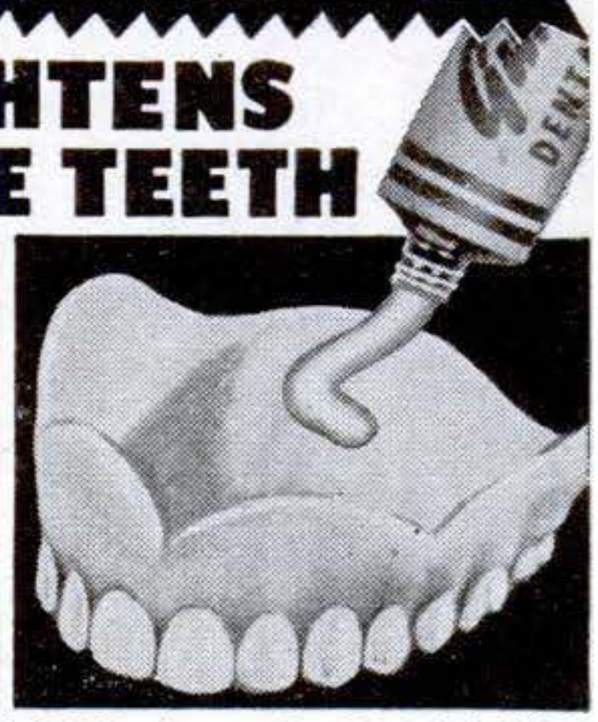

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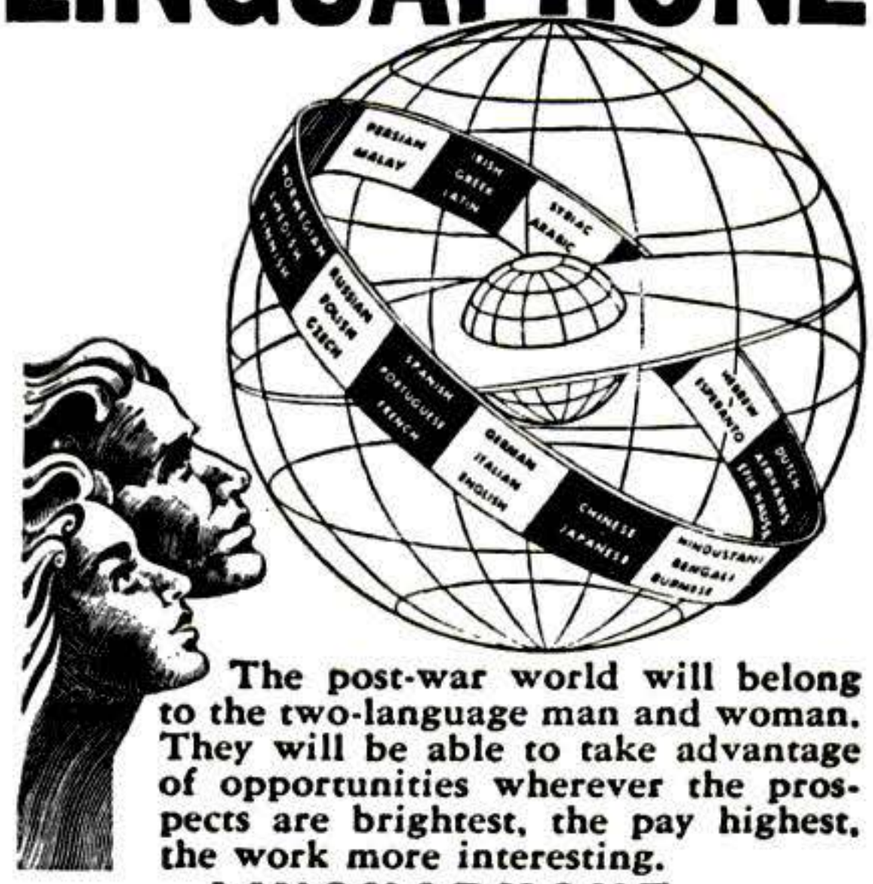

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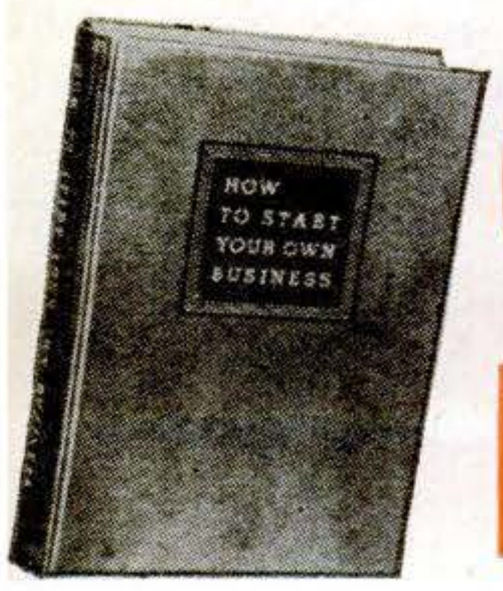

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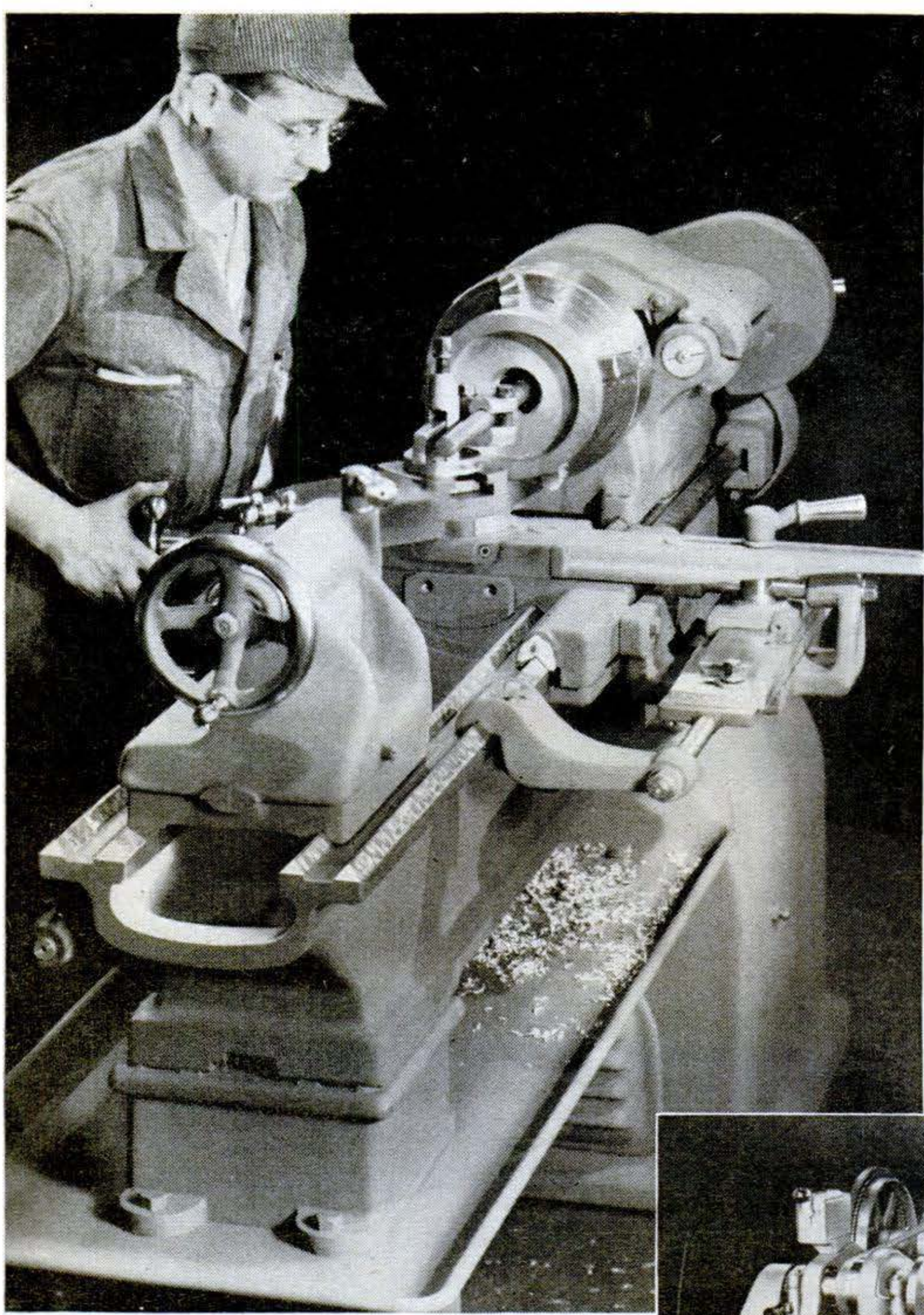

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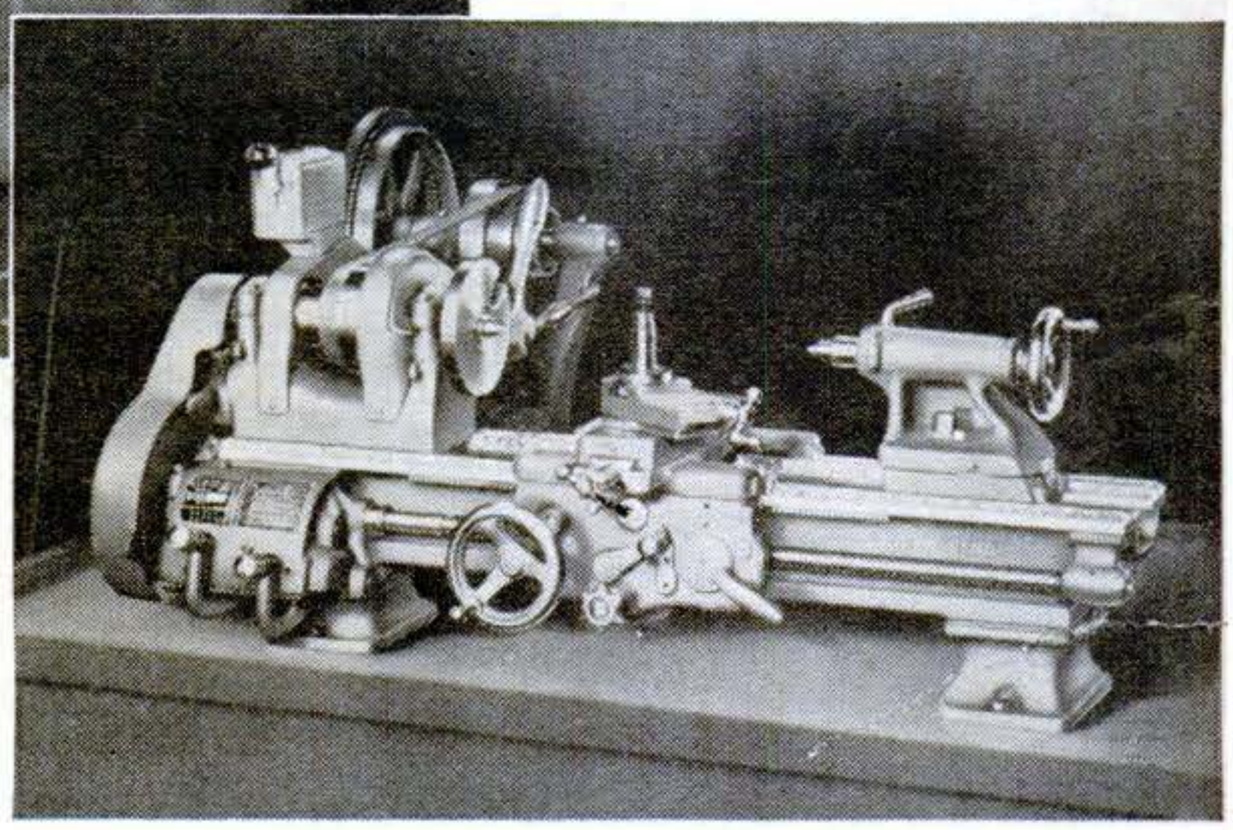

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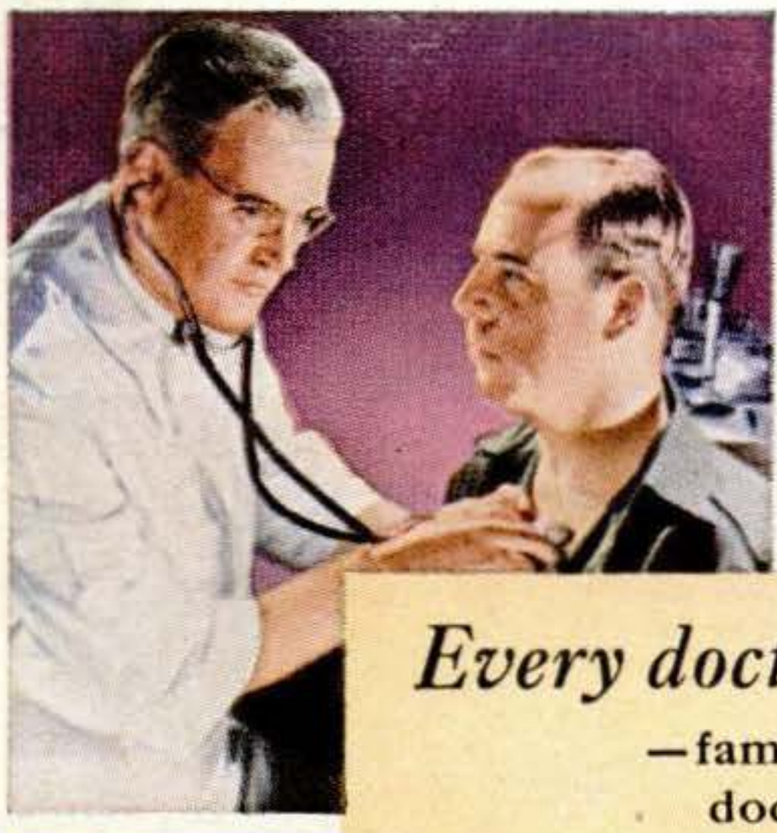

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